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VOL. XVIII

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BULLETINS

OF

AMERICAN PALEONTOLOGY

VOL. XVIII

1931 - 1933

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BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 18

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No. 64

Early Tertiary Mollusca from Wyoming

Contribution from the William Berryman Scott Research Fund,
Princeton University

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Geological Survey of Canada

By
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November 4, 1931

Harris Co.
Ithaca, N. Y.
U. S. A.

EARLY TERTIARY MOLLUSCA FROM WYOMING[1]

INTRODUCTION

The pioneer work of the territorial surveys, and the early activities of the United States Geological Survey, brought to light a great series of non-marine Mollusca from the Upper Cretaceous and Lower Tertiary rocks of the western states. This material, studied principally by F. B. Meek and C. A. White, was described in a number of government reports. The most valuable of these is White's "Review of the Non-marine Fossil Mollusca of North America"[2]. Palaeontologists of later years, however, have shown little interest in these continental mollusks, apparently because of the long geological range, as well as the marked variability, of many species.

Meanwhile, the succession of Tertiary formations in the west has become much better understood than in the days of Meek and White, largely as a result of the systematic study of mammalian faunas. Various field parties of the American Museum of Natural History, while engaged in collecting remains of mammals, obtained a large number of fossil shells, mostly from the lower Tertiary rocks of Wyoming and New Mexico. This material was described by Professor T. D. A. Cockerell, between 1912 and 1915, in the *Bulletin of the American Museum of Natural History*. Cockerell's studies revealed the presence of a rich and interesting molluscan fauna in the lower Tertiary rocks of northwestern Wyoming. However, as the stratigraphy of the sediments was not clearly understood at that time, much of the historical significance of the fossils could not be recognized.

More recently the Princeton University Scott Fund expeditions have entered north-western Wyoming, and in the field seasons of 1927, 1928 and 1929 Professor W. J. Sinclair and Dr. G. L. Jepsen, of Princeton University, obtained, besides rich vertebrate collections, an important series of fossil Mollusca. These shells were turned over to the writer for study, and the results form the subject of the present paper. While few additions can be made to the faunas, as described by Professor Cockerell, it is hoped that the systematic and stratigraphic revision now possible will be an important contribution to the history of North American non-marine Mollusca.

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[1] Published with the permission of the Director, Geological Survey of Canada.

[2] U. S. Geol. Surv., 3rd Ann. Rept., pp. 403-486, 32 pls., 1883.

The writer is much indebted to Professor Sinclair and Dr. Jepsen for the opportunity to study this fine collection. Dr. H. A. Pilsbry, of the Academy of Natural Sciences, Philadelphia, has rendered valuable assistance in the determination of relationships. Dr. C. A. Reeds, of the American Museum of Natural History, kindly placed at the writer's disposal most of the Wyoming material studied by Professor Cockerell. In addition, the writer has utilized the collections of the United States National Museum. The illustrations of this paper were prepared by the writer.

The stratigraphy of the lower Tertiary rocks of north-western Wyoming has been described in detail by Dr. G. L. Jepsen[3]. However, a general summary of the geological succession here will be attempted before proceeding to the systematic descriptions.

Above the Cretaceous, dinosaur-bearing, Lance formation of Bighorn and Clark's Fork basins there is a series of continental beds that have been called Fort Union. The Clark Fork mammalian fauna was discovered[4] in the upper portion of this series and is correlated with the Upper Paleocene (Thanetian). The Princeton expeditions have obtained several faunas at lower horizons, including approximate equivalents of the Torrejon (Middle Paleocene) and Puerco (Lower Paleocene) of New Mexico. Numerous fossil shells were collected from the Torrejon portion of the series, which, for purposes of the present paper, will be designated middle Fort Union. A few specimens of mollusks were found in the upper, or Clark Ford, beds.

The lower Eocene, or so-called Wasatch beds rest upon the Fort Union series. In some places angular unconformities are visible at the contact. Granger[5] divided the "Wasatch" into two stages, a lower or Sand Coulée, and an upper or Gray Bull. These two divisions were distinguished only by the apparent absence, in the lower, of the primitive perissodactyl *Homogalax* (*Systemodon*). As the Princeton expeditions found this genus to be sparingly represented in the Sand Coulée beds[6], the name Gray Bull is applied to the entire "Wasatch" series of north-western Wyoming, although it is convenient to designate the lower portion as "Sand Coulée". The Gray Bull strata, in turn, are overlain by the Wind River series, also Lower Eocene, but this does not enter into the present discussion.

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[3] Proc. Amer. Philosoph. Soc., vol. 69, pp. 480-499, 1930.
[4] Granger, W., Amer. Mus. Nat. Hist., Bull., vol. 33, art. 15, p. 204, 1914.
[5] Op. cit., pp. 203, 205.

The systematic descriptions, which follow, are separated into two sections, one dealing with the Paleocene, or Fort Union fauna, the other with that of the lowest Eocene, the Gray Bull beds.

SYSTEMATIC DESCRIPTIONS

PALEOCENE

Class PELECYPODA

Family UNIONIDÆ

Genus UNIO Retzius

Unio priscus Meek and Hayden ? Pl. 1, fig. 1

> **Unio priscus** Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 117, 1857; Meek, U. S. Geol. Surv. Terr., Rept., vol. 9, p. 516, pl. 43, figs. 8a-8d; White, U. S. Geol. Surv., 3rd Ann Rept., p. 432, pl. 14, fig. 1, 1883; Whiteaves, Geol. Surv. Canada, Contrib. Can. Pal., vol. 1, pt. 1, pp. 26, 65, pl. 10, fig. 3, 1885.

Locality and horizon.—Six miles east of Powell, Park County, Wyoming; middle Fort Union.

Remarks.—Two incomplete shells (Princeton University, Dept. of Geology, No. 20003) from the above locality are referred provisionally to this species because of the presence of concentric wrinkling on the beak, and of two postero-inferiorly directed radiating lines. This type of umbonal ornamentation is present in several other fossil species of *Unio* from western North America, but the present specimens most nearly resemble *Unio priscus* in shape of shell, as far as can be determined. The pseudocardinal dentition also resembles that of certain examples of *Unio priscus*. This species is known from the Upper Cretaceous (Judith River) to the Upper Paleocene (Paskapoo).

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[6] Jepsen, G. L., Proc. Amer. Philosoph. Soc., vol. 69, p. 119, 1930.

Unio wasatchensis Cockerell ? Pl. 1, fig. 2

Unio wasatchensis Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 6, p. 105, pl. 10, figs. 4-6, 1914.

Locality and horizon.—R.99 W., T. 56 N., S. 11 or 12, Park County, Wyoming; middle Fort Union.

Remarks.—The specimen (P. U. No. 20004) referred provisionally to this species shows the umbonal ornamentation of concentric undulations and two posterior lines that are characteristic of several species, such as *Unio priscus,* mentioned above. The present specimen resembles *Unio wasatchensis* most closely in shape of shell. This species is described with the Lower Eocene fauna.

Unio eomargaron Cockerell

Unio eomargaron Cockerell, Amer. Mus. Nat. Hist., Bull., vol, 34, art. 4, p. 123, fig. 2, 1915.

Locality and horizon.—"Head of Big Sand Coulée,' Park County, Wyoming; Clark Fork beds.

Remarks.—As this species is not represented in the Princeton collection, unless by imperfect shells, and as the type is not available to the writer, no description is attempted.

Unio, spp. undt.

Locality and horizon.—South-west edge of Polecat Bench; west side of Polecat Bench; Park County, Wyoming; middle Fort Union.

Remarks.—Several imperfect shells and casts of the interior in the present collection are not determinable. Some of these fossils suggest *Unio danæ* Meek and Hayden, a species that ranges from the Judith River beds to the Paleocene. One cast apparently indicates an undescribed species, with very elongate, Solen-like shell, strong pseudocardinal teeth, which are placed well anteriorly, and a broad internal ridge running from the posterior pseudocardinal tooth downward and backward toward the pallial line. The length of the cast is 103 mm., and the height, 37 mm.

Class GASTROPODA

Family VIVIPARIDÆ

Genus Viviparus Montfort

Viviparus retusus (Meek and Hayden) Pl. 1, figs. 5, 6

Paludina retusa Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 122, 1857.
Vivipara retusa Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 12, p. 185, 1861.
Viviparus retusus Meek, U. S. Geol. Surv. Terr., Rept., vol. 9, p. 575, pl. 44, figs. 5a-5f, 1876; White, U. S. Geol. Surv., 3rd Ann. Rept., p. 467, pl. 24, figs. 1-3, 1883.

Description.—Shell medium in size, broadly conoid, obtuse at apex. Volutions four to five, gently convex; suture slightly impressed; body whorl simetimes rounded, sometimes slightly flattened, with subangular periphery. Aperture broad, angular behind, rounded or subangular in front; inner lip slightly thickened; outer lip thin and retractively oblique. Surface marked by retractive lines of growth, and an occasional faint revolving stria. Length of a large specimen, 24.2 mm.; width, 22.0 mm.

Type.—U. S. National Museum, No. 2155, from Fort Union beds on Missouri river, near mouth of Yellowstone river, North Dakota.

Locality and horizon.—Good specimens from south side of Polecat Bench; poor material from sandstone lens in south-west edge of Polecat Bench; middle Fort Union. Specimens in American Museum labelled "Ralston beds, Head of big Sand coulée." All from Park County, Wyoming.

Remarks.—This species, which is readily recognized by the rounded apex, is widespread in the Paleocene formations (Fort Union, Paskapoo). It is not definitely known from the Upper Cretaceous.

Viviparus paludinaeiformis (Hall) Pl. 1, figs. 3, 4

Turbo paludinaeiformis Hall, in Fremont's Report on the Exploring Expedition to the Rocky Mountains, appendix B, p. 309, pl. 3, figs. 13, 13a, 1845.
Viviparus paludinaeiformis White, U. S. Geol. Surv., 3rd Ann. Rept., p. 468, pl. 30, figs. 11, 12, 1883.

Description.—Shell of medium size, conoid, relatively narrow for the genus. Volutions about five, moderately convex; suture somewhat impressed; body whorl strongly convex at the middle and with faint revolving sinus just in front of suture. Aperture broadly ovate, angular behind, rounded in front; inner lip thickened. Surface marked by slightly sinuous lines of growth. Length of a nearly complete shell, estimated, 26 mm., width 17.0 mm.

Type.—Lost?; from the Knight formation (Wind River group) of south-western Wyoming.

Locality and horizon.—R. 99 W., T. 56 N., S. 11 or 12; south side of Polecat Bench, north of Powell; Park County, Wyoming; middle Fort Union.

Remarks.—This species was said by White to be widespread in the Eocene of the West. The present specimens, although of Paleocene age, appear to be indistinguishable from the shells referred by White to *V. paludinaeiformis.*

Genus CAMPELOMA Rafinesque

Campeloma nebrascensis (Meek and Hayden)

Vivipara nebrascensis Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 12, p. 430, 1861.

Campeloma nebrascensis Henderson, Nautilus, vol. 32, p. 62, 1918.

Paludina multilineata Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 120, 1857.

Vivipara multilineata Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 12, p. 185, 1861.

Campeloma multilineata Meek, U. S. Geol. Surv. Terr., Rept., vol. 9, p. 586, pl. 44, figs. 1a-1c, 1876; White, U. S. Geol. Surv., 3rd Ann. Rept., p. 469, pl. 27, figs. 1-7, 1883.

Campeloma nebrascensis, var. **reticulata**, nov. Pl. 1, fig. 9

Description.—Shell of medium size, broadly but acutely conoid. Volutions about six, convex; suture moderately impressed. Aperture broadly ovate. Surface of posterior whorl smooth; anterior whorls marked by slightly sinuous lines of growth, and by numerous fine revolving ridges, the most prominent one being just anterior to the suture and almost forming a shoulder, remaining ridges progressively finer and more numerous anteriorly. Length of type, estimated, 30 mm., width, as preserved, 18.4 mm.

Type.—Princeton University, Dept. of Geology, No. 20009, from middle Fort Union beds on south side of Polecat Bench, north of Powell, Park County, Wyoming.

Remarks.—This variety includes certain shells from the "Laramie" of Yellowstone River valley, figured by White (pl. 27, figs. 2-4) as varieties of *Campeloma multilineata.*

Campeloma limnaeiformis (Meek and Hayden) ? Pl. 1, fig. 10

Bulimus limnaeiformis Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 118, 1857.

Bulimus nebrascensis Meek and Hayden, ibid.

Thaumastus limnaeiformis Meek, U. S. Geol. Surv. Terr., Rept., vol. 9, p. 553, pl. 44, figs. 8a-8d, 1876; White, U. S. Geol. Surv., 3rd Ann. Rept., p. 454, pl. 25, fig. 24, 1883; Whiteaves, Geol. Surv. Canada, Contrib. Can. Pal., vol. 1, pp. 20, 27, 72, pl. 3, figs. 3-3b, 1885; Russell, Roy. Soc. Canada, Trans., ser. 3, vol. 20, sec. 4, p. 220, pl. 3, figs. 6, 7, 1926.

Campeloma limnaeiformis Russell, Roy. Soc. Canada, Trans., ser. 3, vol. 23, sec. 4, p. 81, pl. 1, figs. 1-3, 1929.

Locality and horizon.—South-west edge of Polecat Bench, Park County, Wyoming; middle Fort Union.

Remarks.—This species appears to be represented in the present collection by a number of specimens, which unfortunately lack the surface. It is a common species in the Paleocene of the north-west.

Genus LIOPLAX Troschel

Lioplax nebrascensis (Meek and Hayden) Pl. 1, figs. 7, 8

Melania nebrascensis Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 124, 1857.

Goniobasis nebrascensis Meek, U. S. Geol. Surv., Terr., Rept., vol. 9, p. 565, fig. 73, pl. 43, figs. 12a-12h, 1876; White, U. S. Geol. Surv., 3rd Ann. Rept., p. 463, pl. 26, figs. 15, 16, 1883.

Campeloma producta White, U. S. Geol. Surv., 3rd Ann. Rept., p. 469, pl. 26, figs. 21-27, 1883.

Description.—Shell of medium size, elongate-ovoid. Spire produced; volutions about six, convex to slightly flattened; anterior whorls sometimes with slight shoulder and faint revolving sinus just in front of suture; suture somewhat impressed. Aperture ovoid, angular behind. Surface marked by sinuous lines of growth and by numerous revolving lines, one or two of which may be prominent at periphery of posterior whorls. Length of a plesiotype, 19.5 mm.; width, 10.8 mm.; length of aperture, 9.0 mm.

Type.—Plesiotypes, U. S. National Museum, Nos. 2138, 2139, 2160; Fort Union beds of western North Dakota.

Locality and horizon.—R. 99 W., T. 56 N., S. 11 or 12, Park County, Wyoming; middle Fort Union.

Remarks.—The writer has found it necessary to include *Goniobasis nebrascensis* and *Campeloma producta* in the same species, because of the presence of numerous intermediate forms. The most satisfactory treatment of the resultant species seems to be to regard it as a member of the genus *Lioplax,* although some extreme forms of the species differ markedly from modern members of this genus. The variety *producta* differs from the typical *Lioplax nebrascensis* in having larger and more elongate shells, with flattened whorls bearing distinct shoulders and sinuses. Some of the specimens in the present collection might be referred to the variety *producta*.

Family MELANIIDÆ

Genus GONIOBASIS Lea

Goniobasis tenuicarinata (Meek and Hayden) ?

Melania tenuicarinata Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 9, p. 137, 1858.
Goniobasis tenuicarinata Meek, U. S. Geol. Surv. Terr., Rept., vol. 9, p. 566, pl. 43, figs. 14a-14c, 1876; White, U. S. Geol Surv., 3rd Ann. Rept., p. 463, pl. 26, fig. 11, 1883.

Locality and horizon.—R. 99 W., T. 56 N., S. 11 or 12, Park County, Wyoming; middle Fort Union.

Remarks.—This species appears to be represented in the present collection by an incomplete impression of the exterior showing the characteristic surface markings (P. U. No. 20013). A number of exfoliated fossils also may represent *G. tenuicarinata.* The species is widespread in the Paleocene and uppermost Cretaceous of the north-west.

Family ENDODONTIDAE

Genus Oreohelix Pilsbry

Oreohelix spp

Locality and horizon.—Near mouth of Little Sand Coulée, Park County, Wyoming; Clark Fork beds.

Remarks.—Two species of helicoids are present in the poorly known Clark Fork fauna. One of these (P. U. No. 20016), from east of the mouth of Little Sand Coulée, probably pertains to *Oreohelix grangeri* Cockerell and Henderson, a species said to come from the Ralston (= Clark Fork) beds, but which is described below with the Gray Bull fauna. The second specimen (P. U. No. 20015), from north-east of the mouth of Little Sand Coulée, is an incomplete, exfoliated shell of a very large snail, possibly *Oreohelix megarche* Cockerell and Henderson, described below. These isolated specimens appear to be fore-runners of the remarkable terrestrial fauna present in the Gray Bull beds.

Remarks on the Paleocene Fauna

As associated material was recorded as such in the field, it is possible to list several Fort Union faunules, each of which is a natural assocation of species.

Faunule from 20 foot sandstone lens, middle Fort Union, on south-west edge of Polecat Bench.

Unio spp.
Viviparus retusus (Meek and Hayden)
Campeloma limnaeiformis (Meek and Hayden) ?

Faunule from middle Fort Union beds in range 99 west, township 56 north, section 11 or 12.

Unio wasatchensis Cockerell ?
Viviparus paludinaeiformis (Hall)
Lioplax nebrascensis (Meek and Hayden)
Goniobasis tenuicarinata (Meek and Hayden) ?

The fauna known from the middle Paleocene beds is, with one or two exceptions, a typical Paleocene assemblage, both as to the species present and the associations of species in faunules. Such a fauna possesses much closer relationships with the mollusks of the continental Upper Cretaceous formations of the west than it does with known faunas of the Lower Eocene. The middle Fort Union shells from north-western Wyoming represent, in almost every case, either descendants of species known in the Upper Cretaceous non-marine faunas or actual survivors of such species.

It also should be noted that only fluviatile and lacustrine genera are present in the middle Fort Union fauna of the present collection.

In contrast to the assemblage just discussed, the imperfect shells from the Clark Fork, or upper Fort Union beds, belong to one fluviatile and one terrestrial genus, and strongly suggest species of the Lower Eocene fauna.

LOWER EOCENE

Class PELECYPODA

Family UNIONIDAE

Genus Unio Retzius

Unio clinopisthus White Pl. 1, fig. 12

Unio clinopisthus White, U. S. Geol. Surv., 3rd Ann. Rept., p. 434, pl. 28, figs. 1, 2, 1883.

Description.—Shell of medium size, elongate-ovoid. Beaks low and anteriorly placed. Anterodorsal and anterior margins regularly rounded; ventral margins sinuous, broadly convex in front of mid-length and gently concave behind; posterior margin abruptly rounded and produced; posterodorsal margin broadly convex and inclined posteroventrally. Rounded umbonal ridge extending obliquely from beak to posteroventral extremity. Area behind umbonal ridge flattened. Surface marked by growth lines. Length of type, 63 mm.; height, 30 mm.; thickness, 23 mm.

Type.—U. S. National Museum, No. 8359; Eocene of Southern Wyoming.

Locality and horizon.—R. 95 W., T. 51 N., S 34., Park County, Wyoming; Gray Bull beds.

Remarks.—The present material, which is from above the "Sand Coulée" horizon, shows some variability in the development of the umbonal ridge. As far as can be determined from shell alone, the species belongs to the modern genus *Margaritana* Schumacher.

Unio wasatchensis Cockerell Pl. 1, fig. 11

Unio wasatchensis Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 6, p. 105, pl. 10, figs. 4-6, 1914.

Description.—Shell of medium size, ovoid and moderately elongate. Beaks anteriorly placed, but normally nearer to mid-length than to anterior extremity of shell. Anterodorsal margin slightly concave or straight, sloping gently toward front; anterior margin abruptly rounded above, becoming broadly convex to meet ventral margin below; ventral margin nearly straight, curving upward gradually toward the ends; posteroventral extremity rather abruptly rounded; posterior margin boardly convex, sloping steeply to the rear; posterodorsal margin staight, diverging somewhat from direction of ventral margin posteriorly, and meeting posterior margin abruptly. Faint, posteriorly sloping, umbonal ridge sometimes developed. Umbo (of well preserved shells) marked by about 10 concentric undulations; two faint diverging lines, posteriorly and somewhat inferiorly directed, visible on some specimens. Growth lines well marked. Length of a complete plesiotype, 56.1 mm.; height, 32.6 mm.; thickness, 14.4 mm.

Type.—American Museum of Natural History, No. 22994; from "Wasatch; Big Horn Basin, Wyoming."

Remarks.—This is a variable species, and some specimens have the posterior margin sloping very obliquely backward. This gives the effect of a produced posteroventral extremity, and shells with this character resemble *Unio clinopisthus* White. However, the absence of a convexity in the ventral margin distinguishes this variety of *U. wasatchensis* from *U. clinopisthus.*

As noted, the horizon of the types of *Unio wasatchensis* was given as Wasatch (i. e., Gray Bull), but the only material in the Princeton collection referable to this species is the specimen mentioned from the Fort Union beds (p. 6, pl. 1, fig. 2). It is possible that the American Museum material actually came from Fort Union beds. Indeed, as pointed out by Cockerell, *U. wasatchensis* is one of a group of species almost, if not entirely, confined to the Upper Cretaceous and Paleocene. *Unio priscus* Meek and Hayden is the most widely spread example, while *U. mendax* White, from the "Wasatch" (possibly Paleocene) of Utah, also belongs to this group.

Unio didymictidis Cockerell

Unio didymictidis Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 34, art. 4, p. 124, fig. 3, 1915.

Locality and horizon.—"North side of Dorsey Creek, nine miles from St. Joe, Big Horn Basin, Wyo."; Gray Bull beds.

Remarks.—The description of this species is omitted here, as the type is not available at present, and there are no examples in the Princeton collection.

Unio sinopæ Cockerell

Unio sinopæ Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 34, art. 4, p. 125, fig. 4, 1915.

Locality and horizon.—"North side of Dorsey Creek, 9 miles from St. Joe"; probably also 15 miles west of Basin, Park County, Wyoming; Gray Bull beds.

Remarks.—The type of this species is not available, and as the single specimen in the Princeton collection is too incomplete to be referred definitely to the species, no description is attempted.

Unio sp.

Locality and horizon.—Little Sand coulée, east of mouth of Pat O'Hara Creek; north of divide at head of Little Sand coulée; Park County, Wyoming; "Sand Coulée beds.

Remarks.—Professor Sinclair informs the writer that beds of *Unio* shells are fairly common in the "Sand Coulée" horizon. These fossils, however, are very difficult to collect entire, and the only specimens obtained were several fragments bearing the pseudocardinal teeth. In the absence of Professor Cockerell's types it is impossible to identify this material specifically.

Class GASTROPODA

Family HELICINIDÆ

Genus Helicina Lamarck

Helicina evanstonensis (White) Pl. 2, figs. 1-6

Helix evanstonensis White, U. S. Geol. & Geog. Surv. Terr., Bull., vol. 4, p. 714, 1878; U. S. Geol. Surv., 3rd Ann. Rept., p. 454, pl. 27, figs. 29-31, 1883.

Gastrodonta (?) **evanstonensis** Cockerell and Henderson, Amer. Mus. Nat. Hist., Bull., vol. 31, art. 20, p. 231, 1912.

Description.—Shell broadly turbinate; spire moderately elevated, with obtuse apical angle. Volutions about five, gently convex; suture slightly impressed; body whorl rounded, occasionally subangular, at periphery flattened in basal region. Aperture broadly semiovate; outer lip apparently simple; inner lip nearly straight, with broad callus covering umbilicus, and slightly thickened anteriorly. Surface marked by moderately retractive lines of growth and traces of fine revolving lines. Length of type, 6.5 mm.; width, 9 mm.

Type.—U. S. National Museum, No. 12502; south-western Wyoming; Evanston formation (Paleocene).

Locality and horizon.—R. 102 W., T. 56 N.; north of divide at head of Little Sand coulée; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; all from lower Gray Bull ("Sand Coulée") beds. 15 miles west of Basin; upper Gray Bull beds.

Park County, Wyoming.

Remarks.—The Gray Bull shells cannot be distinguished from "*Helix*" *evanstonensis,* although evidently from a younger horizon than the type of that species. While there are no traces of opercula, the other characters of the shells strongly suggest the genus *Helicina,* to which the species is here referred. Modern species that compare very closely are *Helicina orbiculata* (Say) and *Hendersonia occulta* (Say).

Family VIVIPARIDÆ

Genus VIVIPARUS Montfort

Viviparus wyomingensis Meek Pl. 2, figs. 7, 8

Viviparus ? wyomingensis Meek, Acad. Nat. Sci. Philadelphia, Proc., p. 182, 1871.

Viviparus wyomingensis White, U. S. Geol. Surv., 3rd Ann. Rept. p. 468, pl. 30, figs. 13, 14, 1883.

Description.—Shell of medium size, obliquely conoid, acute at apex. Spire moderately elongate; volutions five to six, gently convex, the median ones usually bearing a faint shoulder; suture slightly impressed. Aperture broadly ovate, angular behind, regularly rounded in front. Callus well developed but not closely applied to columella, exposing a distinct umbilical chink. Surface marked by numerous moderately obliquely lines of growth, and by fine, irregularly developed, revolving striae, one of which may be prominent near the posterior margin of the median whorls. Length of shell (P. U. No. 20030), 20.5 mm.; width 16.4 mm.; length of aperture, 11.2 mm.

Type.—Lost?; western Sweetwater County, Wyoming; Bridger beds (Middle Eocene).

Locality and horizon.—3 miles south-east of Pat O'Hara creek; north of divide at head of Little Sand coulée; Park County, Wyoming; both occurrences in lower Gray Bull ("Sand Coulée) beds.

Remarks.—Although the type of *Viviparus wyomingensis* is from Middle Eocene rocks, we should expect to find the species, or its close relatives, in the Lower Eocene, for it is undoubtedly a survivor of an important group of Upper Cretaceous and Paleocene viviparids, of which *Viviparus leidyi* and *V. trochiformis* appear to be the most closely related to the present species.

Viviparus leidyi (Meek and Hayden) ?

Paludina leidyi Meek and Hayden, Acad. Nat. Sci. Philadelphia, Proc., vol. 8, p. 123, 1857.
Viviparus leidyi Meek, U. S. Geol. Surv., Terr., Rept., vol. 9, p. 582, pl. 44, fig. 4, 1876; White, U. S. Geol. Surv., 3rd Ann. Rept., p. 467, pl. 24, fig. 7, 1883.

Locality and horizon.—3 miles east of Pat O'Hara creek; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; north of divide at head of Little Sand Coulée; all from lower Gray Bull ("Sand Coulée") beds; Park County, Wyoming.

Remarks.—The specimens from the "Sand Coulée" beds have the typical characters of the species, but as none of the shells is complete, the reference is tentative.

Viviparus jepseni, sp. nov. Pl. 2, figs. 9, 10

Description.—Shell of medium size, broadly and obliquely ovoid. Spire moderately elongate, obtuse at apex; volutions about five, moderately convex; body whorl well rounded at periphery; suture slightly impressed. Aperture subovate; outer lip very convex; inner lip nearly straight. Surface marked by numerous distinct, oblique lines of growth. Length of type, 22.3 mm.; width, 16.7 mm.

Type.—Princeton University, Dept. of Geology, No. 20034.

Locality and horizon.—East of Stein's (holotype); 15 miles west of Basin; both in Park County, Wyoming; upper Gray Bull beds.

Remarks.—This species apparently is a close relative of *Viviparus retusus* of the Paleocene. Specimens of *V. jepseni*, however, may be distinguished by the narrower shell, the more elongate spire and the rounded, rather than keeled, body whorl.

Family MELANIIDÆ

Genus GONIOBASIS Lea

Goniobasis carterii Conrad Pl. 2, figs. 11-13

Goniobasis carterii Conrad, Amer. Jour. Conchol., vol. 4, p. 280, pl. 18, figs. 6, 7, 1869.
Goniobasis tenera, var. **carteri** White, U. S. Geol. Surv., 3rd Ann. Rept., p. 464, pl. 31, figs. 19, 25, 28, 1883.

Description.—Shell elongate-conoid. Volutions about nine, convex, regularly increasing in size; suture somewhat impressed. Aperture broadly ovoid, angular behind, rounded in front. Surface of whorls marked by sinuous lines of growth, by revolving lines, and by prominent, regularly spaced, transverse ribs, most prominent just behind middle of whorl, and somewhat lobate at intersections with revolving lines. Length of a large specimen (fig. 13), as preserved, 27.6 mm.; width, 10.4 mm.; length of aperture, 7.1 mm.

Type.—Lost?; "Barrel Springs, Wyoming Territory".

Locality and horizon.—"Sand Coulée" beds; 3 miles east of Pat O'Hara creek; north of divide at head of Little Sand Coulée. Upper Gray Bull beds; Dry creek. All in Park County, Wyoming.

Remarks.—This species is close to, and perhaps only a variety of, *Goniobasis tenera* (Hall). The principal distinction is the greater prominence and regularity of the ribs on specimens of *G. carterii.*

Family LYMNAEIDÆ

Genus PLANORBIS Müller

Planorbis storchi, sp. nov. Pl. 2, figs. 17-19

Description.—Shell rather small, discoidal, dextral. Spire depressed; volutions rounded, about five in number; suture slightly impressed. Aperture subcircular; lips apparently thin and simple. Surface marked by oblique lines of growth, and by numerous revolving lines, the latter becoming well spaced and quite distinct near periphery. Length of type, 3.3 mm.; maximum diameter, 13.0 mm.; width of body whorl near aperture, 3.3 mm.

Type.—Princeton University, Dept. of Geology, No. 20042; 15 miles west of Basin, Wyoming; upper Gray Bull beds.

Remarks.—This species apparently belongs to the subgenus *Gyraulus* Agassiz, although nothing very like these shells occurs in the modern North American fauna. Among fossil species there is a very close resemblance to *Planorbis cirratus* White[7], and the Gray Bull specimens would be referred to that species but that White has stated that *P. cirratus* is without revolving lines.

The present species is named in honor of Mr. T. C. von Storch, a member of the Princeton Expedition of 1927, to whose interest is due the collecting of much of the Gray Bull material.

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[7] U. S. Geol. & Geog. Surv. Terr., Ann Rept. for 1878, pt. 1, p. 44, pl. 19, figs. 5a-5c, 1883.

Family PHYSIDÆ

Genus PHYSA Draparnaud

Physa bridgerensis Meek Pl. 2, figs. 14, 15

Physa bridgerensis Meek, U. S. Geol. Surv. Terr., Ann. Rept. for 1872, p. 516, 1873; White, U. S. Geol. & Geog. Surv. Terr., Ann. Rept. for 1878, pt. 1, p. 45, pl. 19, figs. 10a, 10b, 1883.

Description.—Shell rather large, elongate-ovoid. Spire relatively elongate, conical, acute; volutions about five, gently convex; body whorl not inflated; suture faintly impressed. Aperture narrowly ovoid, acutely angular behind; columnella folded, sometimes doubly. Surface marked by numerous lines of growth. Length of type, about 29 mm.; width, about 17 mm.

Type.—Lost; neotype, U. S. National Museum, No. 9001; both from Bridger (Middle Eocene) beds in western Sweetwater County, Wyoming.

Locality and horizon.—15 miles west of Basin, Park County, Wyoming; upper Gray Bull beds.

Remarks.—The Lower Eocene specimens seem relatively more elongate than is typical of the species, but this may be due largely to the fact that the body whorl is partly broken away in all the examples before the writer.

The relatively elongate spire would place this species in the genus *Aplexa* Fleming, if an attempt were made to recognize that genus among fossil Physidae. Such a procedure does not seem justifiable for material of late Cretaceous and early Tertiary age, as some variable species of that time would include, on conchological grounds, representatives of both *Physa* and *Aplexa*.

Physa pleromatis White Pl. 2, fig. 16

Physa pleromatis White, U. S. Geog, Surv. W. 100th Merid., Rept., vol. 4, p. 211, pl. 21, figs. 1a, 1b, 1877.

Description.—Shell large, broadly ovoid. Spire slender, somewhat elongate; volutions about six in number, moderately convex; body whorl inflated, about three times length of spire. Aperture arcuate, angular behind, narrowly rounded in front; columella folded. Surface marked by obscure lines of growth. Length of type, 32 mm.; width, 22 mm.

Type.—U: S. National Museum, Nos. 8867 and 8876; Lower Eocene beds in central Utah.

Locality and horizon.—15 miles west of Basin, Park County, Wyoming; upper Gray Bull beds.

Remarks.—The characters of this species suggest the genus *Aplexa,* rather than *Physa,* but, as pointed out above, this distinction is of doubtful value with these fossils.

Physa sp.

Locality and horizon.—R. 102 W., T. 56 N.; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; both in Park County, Wyoming "Sand Coulée" beds.

Remarks.—Several fragmentary shells from the above-mentioned localities may represent immature individuals of *Physa pleromatis,* but this cannot be determined.

Family POLYGYRIDÆ

Genus POLYGYRA Say

Polygyra veternior (Cockerell) Pl. 2, figs. 20-29

Helix veterna veternior Cockerell, Amer. Mus. Nat. Hist., Bull., vol., vol. 34, art. 3, p. 117, fig. 3, 1915.

Description.—Shell of medium size, broadly ovoid or approximately planoconvex. Spire short to almost flat, usually very obtuse; volutions about four and a half, gently convex; body whorl large, well rounded; suture little impressed. Aperture obliquely ovoid; anterior part of inner lip and probably entire outer lip reflected; umbilicus usually closed. First one or two whorls smooth, remainder marked by fine retractive lines of growth. Length of type, 11.7 mm.; maximim diameter, 17.6 mm.

Type.—American Museum of Natural History, No. 22359.

Locality and horizon.—R. 102 W., T. 56 N.; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; north of divide at head of Little Sand Coulée; 5 miles south-east of mouth of Pat O'Hara creek (type locality); all in "Sand Coulée" beds. 15 miles west of Basin; upper Gray Bull beds, Park County, Wyoming.

Remarks.—Although this species is rather variable as to proportions, it differs from *"Helix" veterna* Meek and Hayden[8] in having a shorter shell and a more oblique and narrower aperture. Probably specimens with complete apertures would show additional differences. The type of *Helix veterna veternior* Cockerell is regarded, therefore, as specifically, if not generically, distinct from *"Helix" veterna.* The reference of the present species of *Polygyra* is, of course, provisional, but the shape of the shell and the characters of the aperture strongly suggest that genus.

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[8] U. S. Geol. Surv. Terr., Rept., vol. 9, p. 596, figs. 84, 85; pl. 42, figs. 8a, 8b, 1876.

Polygyra eohippina (Cockerell) Pl. 2, figs. 30-32

Pleurodonte eohippina Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 34, art. 3, p. 119, fig. 4, 1915.

Description.—Shell rather small, flattened and lenticular. Spire very short and obtuse; volutions probably about five, nearly flat; body whorl with acute peripheral keel (partly due to crushing?). Aperture narrowly ovoid; basal portion of peristome nearly straight, somewhat reflected, and with a medially placed tooth or lamina. Umbilicus closed by callus. Surface marked by fairly distinct lines of growth. Length of type, 5.0 mm.; maximum diameter, 11.7 mm.

Type.—American Museum of Natural History, No. 22357; head of Big Sand coulée, Park County, Wyoming; "Sand Coulée" beds.

Remarks.—This species is known only from the imperfect type specimen, so that a definite determination of relationships is impossible. Nevertheless it seems very doubtful that *Pleurodonte* is represented, as this genus is largely restricted to South America. The lenticular shape of shell and the basal tooth are characters found in a number of genera. Some species of the European genus *Caracollina* of Beck resemble the present specimen more closely than does any other material examined by the writer. However, since the characters of the present species fall within the range of the large American genus *Polygyra* it seems best to refer *"Pleurodonte" eohippina* provisionally to that genus. Very similar shells, however, are found in species of *Ashmunella* Pilsbry and Cockerell.

Family SAGDIDÆ

Genus MICROPHYSULA Pilsbry and Cockerell

Microphysula oxyaenæ (Cockerell) Pl. 4, figs. 24-26

Thysanophora oxyaenæ Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 24, p. 325, fig. 5, 1914.

Description.—Shell small, but of medium size for the genus, close-coiled, slightly convex; suture nearly linear; body whorl well rounded. Aperture semilunate. Umbilicus wide, equaling about one-third of shell diameter, and exposing penultimate whorl. Surface marked by numerous fine lines of growth. Length of type, 2.5 mm.; maximum diameter, 4.7 mm.; maximum diameter of aperture, 1.8 mm.

Type.—American Museum of Natural History, No. 22986; 5 miles south-east of mouth of Pat O'Hara creek, Park County, Wyoming; "Sand Coulée" beds.

Remarks.—Cockerell's comparison of this species with *"Thysanophora" ingersolli* (Bland) is very good. However, the latter species is now known as *Microphysula ingersolli*, and a similar change of genus, therefore, is made here for the fossil species. In the original description of *Microphysula oxyaenæ* Cockerell described the body whorl as "elevated next to the suture". The present writer regards this appearance as the result of crushing.

Microphysula sinoparum (Cockerell) Pl. 2, figs. 33-35

Vitrea sinoparum Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 24, p. 325, fig. 4, 1914.

Description.—Shell small, but of medium size for the genus. Spire nearly flat; volutions five, rather closely coiled, faintly convex; suture nearly linear; body whorl well rounded. Aperture broadly semilunate; peristome apparently simple. Umbilicus wide, equal to about one-third maximum diameter of shell, and exposing much of penultimate whorl. Surface marked by fine obscure lines of growth. Length of type, 2.4 mm.; maximum diameter, 5.3 mm.; maximum diameter of aperture, 1.2 mm.

Type.—American Museum of Natural History, No. 22987; 5 miles south-east of mouth of Pat O'Hara creek, Park County, Wyoming; "Sand Coulée" beds.

Remarks.—The size of the shell and the diameter of the umbilicus are too large in this species to be typical of *Vitrea*. There is a closer resemblance to certain species of *Zonitoides* Lehman. However, there is much similarity between the present species and *Microphysula oxyaenæ*, described above; indeed, the only important difference is seen in the shape of the aperture. The resemblance of *"Vitrea" sinoparum* to modern species of *Micro-*

physula, such as *M. cookei* (Pilsbry), also is marked, and for these reasons the writer places the present species provisionally in *Microphysula*.

Genus GASTRODONTA Albers

Gastrodonta coryphodontis Cockerell Pl. 3, figs. 1-6

Gastrodonta coryphodontis Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 6, p. 105, pl. 9, figs. 4-6, 1914.

Description.—Shell large for the genus; rounded-conoid in shape. Spire moderately elongate, obtuse at apex; volutions five, moderately convex; body whorl rounded or with peripheral angulation; suture slightly impressed. Aperture broadly ovate; inner lip with broad callus, closing or almost closing umbilicus; outer lip thickened and slightly reflected basally, probably entirely so. Surface marked by numerous fine, retractive costulæ, most distinct and regular on first one and a half whorls. Length of type, 11.3 mm.; width, 11.7 mm.

Type.—American Museum of Natural History, No. 22361.

Locality and horizon.—R. 100 W., T. 56 N., S. 33; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; north of divide at head of Little Sand Coulée; 5 miles south-east of mouth of Pat O'Hara creek (type locality); all from "Sand Coulée" beds in Park County, Wyoming.

Remarks.—Although shells of this species are fairly common, none so far collected shows the complete peristome. For this reason the reference to *Gastrodonta* is provisional.

Family ENDODONTIDÆ

Genus OREOHELIX Pilsbry

Oreohelix megarche Cockerell and Henderson Pl. 3, figs. 7-12

Oreohelix megarche Cockerell and Henderson, Amer. Mus. Nat. Hist. Bull., vol. 31, art. 20, p. 230, pl. 22, figs. 4-6, 1912.

Description.—Shell large, compressed. Spire short and quite obtuse; volutions about five, almost flat, but with shallow revolving furrow close to distal margin; body whorl subangular to broadly rounded at periphery, moderately convex basally. Aperture subquadrate or broadly ovoid. Umbilicus with steep sides, diameter not quite equal to one-third maximum diameter of shell. First two whorls with distinct, regular, retractive costulæ, between six and eight to the millimeter; remainder of shell with close-set, irregular, retractive lines and costulæ. Length of an average specimen, 19.8 mm.; maximum diameter, 38.2 mm.

Type.—American Museum of Natural History; from 3 miles south-east of Otto, Wyoming.

Locality and horizon.—"Sand Coulée" beds; 3 miles south-east of mouth of Pat O'Hara creek; R. 102 W., T. 56 N.; Little Sand Coulée basin, east of mouth of Pat O'Hara creek; north of divide at head of little Sand coulée. Upper Gray Bull beds: 15 miles west of Basin; east of Stein's. All in Park County, Wyoming.

Remarks.—The shells of this species are among the largest referred to *Oreohelix*, being approached in this respect only by *O. nacimientensis* (White)[9] from the Torrejon of New Mexico and *O. thurstoni* (Russell)[10] from the Paleocene of Alberta. The last mentioned species might well be the ancestor of *O. megarche*.

Oreohelix grangeri Cockerell and Henderson Pl. 3, figs. 13-18

Oreohelix grangeri Cockerell and Henderson, Amer. Mus. Nat. Hist., Bull., vol. 31, art. 20, p. 231, pl. 21, figs. 5-9, 1912.

Description.—Shell rather large, very compressed. Spire short and very obtuse; volutions about four, flattened, the median ones with slight revolving furrow on distal side; body whorl acutely angulate at periphery, gently convex below; suture almost linear. Aperture subquadrate. Umbilicus almost one-fifth maximum diameter of shell. Surface of first two whorls marked by fine, regular, retractive costulæ, seven to twelve in a millimeter; remainder of shell with less regular costulæ. Length of an adult specimen, 11.5 mm.; maximum diameter, 21.0 mm.

Type.—American Museum of Natural History; from "Bighorn Basin, Wyoming". Said to be from the Ralston (= Clark Fork) beds.

Locality and horizon.—"Sand Coulée" beds: R. 102 W., T. 56 N.; north of divide at head of Little Sand coulée; Little Sand Coulée basin, east of mouth of Pat O'Hara creek. Upper Gray Bull beds: 15 miles west of Basin. All in Park County, Wyoming.

Remarks.—Professor Cockerell's generic reference and comparisons of this species are corroborated by the Princeton material. The present writer is inclined, however, to question the occurrence of the type in Clark Fork beds, as the Princeton collection contains numerous shells from various levels in the Gray Bull beds and only a single, doubtful specimen from a Clark Fork horizon.

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[9] U. S. Geol. Surv., Bull. 34, p. 26, pl. 5, figs. 3-7. 1886.

[10] Roy. Soc. Canada, Trans., ser. 3, vol. 20, sec. 4, p. 219, pl. 3, figs. 3-5, 1926; ibid, vol. 23, p. 85, pl. 1, fig. 11, 1929.

Oreohelix sp.

Remarks.— Several specimens from "Sand Coulée" beds north of the divide at the head of Little Sand coulée seem to represent an undescribed species of *Oreohelix*. They are moderately compressed shells, with sharply rounded or subangular peripheries and small umbilici. The best preserved specimen is 13 mm. in length and 15.5 mm. in maximum diameter.

A large, poorly preserved cast of the interior, from east of Stein's, represents a shell very like that described by Meek and Hayden as *Planorbis planoconvexus*[11]. The present specimen suggests *Oreohelix* much more than *Planorbis*, and it is possible that the species of Meek and Hayden should be known as *Oreohelix planoconvexa*.

Genus GONYODISCUS Fitzinger

Gonyodiscus ralstonensis (Cockerell) **Pl. 3, figs. 19-24**

Pyramidula ralstonensis Cockerell, Amer. Mus. Nat. Hist., **Bull.**, vol. 33, art. 6, p. 101, pl. 8, figs. 1, 2, 1914.

Description.—Shell of medium size for the genus. Spire obtuse but relatively prominent, with pointed apex; volutions about five, convex; last whorl well rounded; suture somewhat impressed. Aperture subovate, peristome probably simple. Umbilicus deep, slightly more than one-sixth maximum diameter of shell. Surface of first one or two whorls smooth, remainder marked by distinct, regular, sinuous, retractive costulæ, about six to the millimeter on the body whorl. Length of type, a medium-sized specimen, 4.4 mm.; maximum diameter, 6.9 mm.; diameter of umbilicus, 1.2 mm.

Type.—American Museum of Natural History, No. 22356; from 3 miles south-east of mouth of Pat O'Hara creek. Said to be from Ralston (i. e., Clark Fork) beds, but almost certainly from the "Sand Coulée" horizon.

Locality and horizon.—"Sand Coulée" beds: R. 102 W., T. 56 N.; north of divide at head of Little Sand coulée; Little Sand Coulée basin, east of mouth of Pat O'Hara creek. Upper Gray Bull beds: 15 miles west of Basin. All in Park County, Wyoming.

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[11] U. S. Geol. Surv. Terr., Rept., vol. 9, p. 538, pl. 44, figs. 9a-9c, 1876.

Remarks.—This species is removed from *Pyramidula* to *Gonyodiscus* in accordance with more recent views on the classification of the Endodontidæ.

Family GRANGERELLIDÆ, nov.

Definition.—Shell of medium or small size; rounded conoid in shape. Proximal portion of body whorl deflected toward apex, crossing spire obliquely. Aperture, where known, subtrigonal in shape, with outer lip thickened and reflected and with a basal and a lateral tooth.

Remarks.—This family, while probably belonging to the Pulmonata, is otherwise *incertæ sedis*. For more detailed discussion of relationships, see below.

Genus GRANGERELLA Cockerell

Grangerella megastoma Cockerell Pl. 4, figs. 1-4

Grangerella megastoma Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 34, art. 3, p. 116, fig. 1, 1915.

Description.—Shell medium-sized. Spire with gently convex sides; volutions about seven, those of spire almost flat; body whorl well rounded, slightly flattened on base, proximal end sharply deflected backward to reach apex, more or less constricted close to aperture; suture almost linear. Aperture broadly subtrigonal, opening obliquely backward, posterior angle in contact with apex of spire, anterior angle at periphery of body whorl; inner lip with a broad, thin, semicircular callus extending from apex to periphery; outer lip strongly thickened and slightly reflected, with faint sinus near posterior angle; two prominent lamellar teeth, one basal, the other lateral and opposite, and corresponding sinuses on exterior of body whorl. Umbilicus closed. Surface marked by faint, retractive costulæ, between four and eight to the millimeter on body whorl. Length of type, 9.0 mm.; maximum diameter, about 14 mm.

Type.—American Museum of Natural History, No. 22256; from "Sand Coulée" beds at head of Big Sand coluée, Park County, Wyoming.

Locality and horizon.—Little Sand coulée, east of mouth of Pat O'Hara creek; north of divide at head of Little Sand coulée; all from "Sand Coulée" beds in Park County, Wyoming.

Remarks.—The writer has been able to free the aperture of the type of this species from matrix, exposing the dentition. This is different from anything in the existing North American fauna. Regarding the structure of the aperture as fundamental, and the deflected form of the body whorl as a subsidary specialization, it becomes improbable that the genus *Grangerella* belongs to either the Bulimulidæ or the Pupillidæ. The aperture is very like that of certain tropical American Helicinidæ, e. g., *Lucidella,* but the deflected body whorl is unknown in this family. The only arrangement consistent with our present knowledge involves the erection of a new family for *Grangerella* and the closely related genus *Protoboysia.* Whatever the true relationship, *Grangerella* is not a mere local development, for the genus is now known from the Paleocene of Alberta[12].

Grangerella sinclairi (Cockerell) Pl. 4, figs. 5-15

Gastrodonta (?) **evanstonensis** var. **sinclari** Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 31, art. 20, p. 231, pl 21, figs. 1, 2, 1912.
Boysia sinclari Cockerell ibid, vol. 33, art. 24, p. 324, fig. 2, 1914.
Boysia phenacodorum Cockerell, loc. cit., fig. 3.
Grangerella (?) **sinclairi** Cockerell, ibid, vol. 34, art. 3, p. 117, 1915.
Grangerella (?) **phenacodorum** Cockerell, loc. cit.

Description.—Characters as in *G. megastoma,* but posterior angle of aperture barely reaching second, or even third whorl. Sinus at posterior angle of aperture more distinct than in *G. megastoma.* Length of an adult specimen, 8.7 mm.; maximum diameter, 13.3 mm.

Type.—American Museum of Natural History; from "Sand Coulée" beds (?) "about three miles north of Ralston", Wyoming.

Locality and horizon.—"Sand Coulée beds: 6 miles south-east of Hopkins Ranch; 5 miles south-east of Pat O'Hara creek; head of Big Sand coulée; 3 miles east of mouth of Pat O'Hara creek; north of divide at head of Little Sand coulée; Little Sand Coulée basin, east of mouth of Pat O'Hara creek. Upper Gray Bull beds: 15 miles west of Basin. All in Park County, Wyoming.

Remarks.—The study of a large series of shells in the Princeton collection has convinced the writer that *"Boysia" phenacodorum* was established on a young shell of *"Boysia" sinclairi.* Several of the Princeton specimens permit the working out of the aperture, which proves to be almost identical in character with that of *Grangerella megastoma.* The present species, therefore, may be referred to *Grangerella* without question.

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[12] Russell, Roy. Soc. Canada, Trans., ser. 3, vol. 23, sec. 4, p. 88, 1929.

Genus PROTOBOYSIA Cockerell

Protoboysia complicata Cockerell Pl. 4, figs. 16-23

Protoboysia complicata Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 33, art. 34, p. 323, fig. 1, 1914.

Description.—Shell small. Spire with convex sides and obtuse apex; volutions about seven, nearly flat, suture linear; body whorl rounded at periphery, flattened on base, deflected sharply and obliquely toward apex but curving around spire at second volution and descending slightly on opposite side; deeply impressed transverse constriction on body whorl near point of deflection, and about level and parallel with last suture. Aperture subtrigonal, situated at level of whorls 3 to 5; inner lip with callus; lateral and basal tooth present, as shown by sinuses on exterior of body whorl. Surface marked by fine retractive costulæ, and in some specimens by a faint keel on the undeflected portion of last whorl. Length of type, 3.5 mm.; maximum diameter, 3.5 mm.

Type.—American Museum of Natural History, No. 22255; from "Sand Coulée" beds: 5 miles south-east of Pat O'Hara creek, Park County, Wyoming.

Locality and horizon.—"Sand Coulée" beds north of divide at head of Little Sand coulée, Park County, Wyoming.

Remarks.—This extradorinary little shell is shown by the above description to be closely related to the species of *Grangerella.* The present species differs principally in the greater prolongation of the deflected body whorl and in the peculiar constriction of that volution.

Icertæ sedis

"Eucalodium" eophilum Cockerell Pl. 4, fig. 27

Eucalodium eophilum Cockerell, Amer. Mus. Nat. Hist., Bull., vol. 34, art. 3, p. 117, fig. 2, 1915.

Description.—Shell of medium size, rounded-conical, moderately broad. Spire tapering but rounding to apex, moderately elongate; volutions six, flattened, increasing in size rather regularly; last whorl not inflated, sharply rounded or subangular at periphery; suture apparently linear. Aperture obliquely ovoid. Columella apparently imperforate. Surface unknown. Length of type, as preserved, 15.3 mm.; width, 11.0 mm.; length of aperture, 7.5 mm.

Type.—American Museum of Natural History, No. 22257; from 3 miles east of mouth of Pat O'Hara creek, Park County, Wyoming; "Sand Coulée" beds.

Remarks.—According to the writer's interpretation of this fossil, all the whorls are represented, at least in part. The apex, therefore, is not decollate, and the shell is too short and stout to be referred to *Eucalodium* or related genera. There is more resemblance to some of the larger pupillids. but even here the similarity is not marked. In the absence of a definite clue to the true generic position it seems best to designate the species *"Eucalodium" eophilum.* More perfect material alone will decide the correct relationships.

Remarks on the Lower Eocene Fauna

The faunules of associated species in the "Sand Coulée" and upper Gray Bull beds show a uniformity of composition that is in contrast to the associations in the underlying Paleocene.

Faunule from "Sand Coulée" beds in Little Sand Coulée" basin, east of the mouth of Pat O'Hara creek.

Helicina evanstonensis (White)
Physa sp.
Polygyra veternior (Cockerell)
Gastrodonta coryphodontis Cockerell
Oreohelix megarche Cockerell and Henderson
Oreohelix grangeri Cockerell and Henderson
Gonyodiscus ralstonensis (Cockerell)
Grangerella megastoma Cockerell
Grangerella sinclairi (Cockerell)

Faunule from "Sand Coulée" beds north of divide at head of Little Sand coulée.

Viviparus wyomingensis Meek
Goniobasis carterii Conrad
Oreohelix grangeri Cockerell and Henderson

Faunule from upper Gray Bull beds 15 miles west of Basin.

Unio sinopæ Cockerell ?
Helicina evanstonensis (White)
Viviparus jepseni Russell
Planorbis storchi Russell
Physa bridgerensis Meek
Physa pleromatis White
Ploygyra veternior (Cockerell)
Oreohelix megarche Cockerell and Henderson
Oreohelix grangeri Cockerell and Henderson
Gonyodiscus ralstonensis (Cockerell)
Grangerella sinclairi Cockerell

Turning to the consideration of entire faunas, it will be seen from the locality data given for the various species that there is slight difference between the fauna of the "Sand Coulée" beds and that of the upper Gray Bull. *Goniobasis carterii* and the Viviparidæ seem to be more common in the lower horizons, but otherwise the differences can be ascribed plausibly to the chances of collecting. We may consider, therefore, the Mollusca of the Gray Bull stage, using the latter term in the comprehensive sense here adopted, as constituting a single, well-marked fauna. The species of this Lower Eocene fauna are, with few exceptions, either confined to the Gray Bull beds, or are known elsewhere only from Eocene strata. As to habitat, almost three-quarters of the genera represented are terrestrial, and if species and individual specimens are considered, the aquatic element becomes almost insignificant.

CONCLUSIONS

The almost continuous section of lower Tertiary rocks in northwestern Wyoming contains abundant remains of nonmarine Mollusca, which show the change from Paleocene to Lower Eocene faunas in a relatively local area. The oldest fauna is in the middle Fort Union, and consists of aquatic species, mostly of Paleocene and Upper Cretaceous affinities. Presumably the great change began in late Paleocene time, for the next stage, the Clark Fork or upper Fort Union, contains a few shells of Eocene type. The Lower Eocene "Wasatch" or Gray Bull stage contains a fairly uniform fauna, predominantly terrestrial in habitat and of

Eocene affinities. Several species present here also occur in later Eocene horizons, suggesting that when the fauna of the Wind River group is known it will be found to be essentially like that of the Gray Bull.

The cause of this profound change in molluscan fauna is almost certainly to be found in the elevation of the Rocky Mountains. While it is known that uplift went on intermittently throughout the Late Cretaceous and Paleocene, a very important period of orogeny occurred, as shown by unconformities, following the deposition of the Clark Fork stage. This elevation and accompanying change of climate, while probably not profound, were sufficient to drive out or destroy the aquatic Paleocene faunas, and to provide the correct environment for a dominantly terrestrial fauna, which was already migrating in, presumably from the north. It is reasonable to suppose that this fauna, in turn, was modified by the renewed uplift of late Eocene or Oligocene time.

PLATE I

EXPLANATION OF PLATES

Plate 1

All figures natural size.

Figure Page

Unio priscus Meek and Hayden? 5
1. Internal view of imperfect left valve. Princeton University, Department of Geology, No. 20003. Middle Fort Union.

Unio wasatchensis Cockerell ? 6
2. External view of left valve. P. U. No. 20004. Middle Fort Union.

Viviparus paludinaeiformis (Hall) 7
3. Dorsal view. P. U. No. 20008. Middle Fort Union.
4. Ventral view of same.

Viviparus retusus (Meek and Hayden) 7
5. Dorsal view. American Museum of Natural History, No. 22997. Fort Union.
6. Ventral view of same.

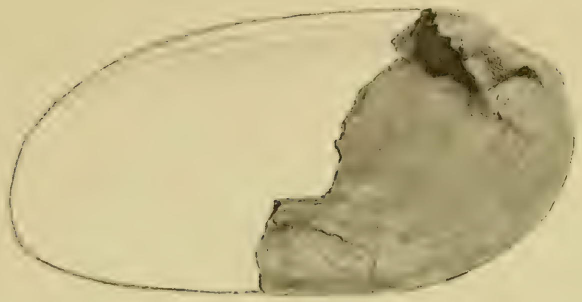
Lioplax nebrascensis (Meek and Hayden) 9
7. Dorsal view. P. U. No. 20011. Middle Fort Union.
8. Ventral view of same.

Campeloma nebrascensis, var. reticulata, nov. 8
9. Ventral view of holotype. P. U. No. 20009. Middle Fort Union.

Campeloma limnaeiformis (Meek and Hayden) ? 9
10. Ventral view. P. U. No. 20012. Middle Fort Union.

Unio wasatchenis Cockerell 6
11. External view of left valve. A. M. N. H. No. 22994. Gray Bull?

Unio clinopisthus White 12
12. External view of left valve. P. U. 20017. Gray Bull.



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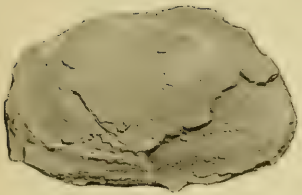

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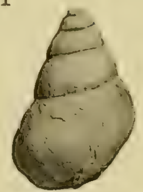

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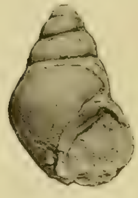

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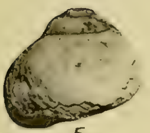

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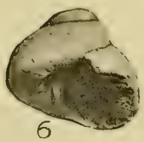

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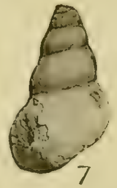

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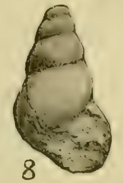

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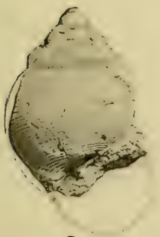

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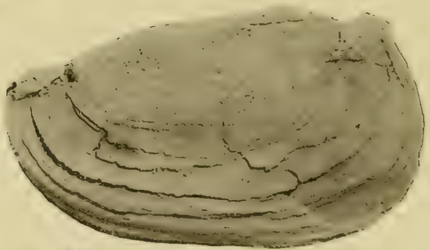

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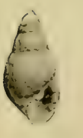

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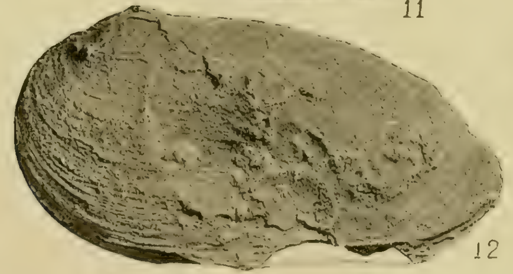

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PLATE II

Plate 2

Figure **Page**

Helicina evanstonensis (White) **14**

1. Apical view. Princeton University, Dept. of Geology, No. 20023. Gray Bull (Sand Coulée"). X 2.
2. Basal view of same. X 2.
3. Ventral view of same. X 2.
4. Apical view. P. U. No. 20021. Gray Bull (upper). X 2.
5. Basal view of same. X 2.
6. Ventral view of same. X 2.

Viviparus wyomingensis Meek **15**

7. Dorsal view. P. U. No. 20030. Gray Bull ("Sand Coulée"). X 1.
8. Ventral view of same. X 1.

Viviparus jepseni, sp. nov. **16**

9. Dorsal view of holotype. P. U. No. 20034. Gray Bull (upper). X 1.
10. Ventral view of same. X 1.

Goniobasis carterii Conrad **16**

11. Dorsal view. P. U. No. 20041. Gray Bull ("Sand Coulée"). X 1.
12. Dorsal view of another specimen. X 1.
13. Ventral view of another specimen. X 1.

Physa bridgerensis Meek **18**

14. Dorsal view. P. U. No. 20045. Gray Bull (upper). X 1.
15. Ventral view of another specimen. X 1.

Physa pleromatis White **18**

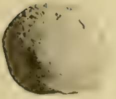
16. Dorsal view. P. U. No. 20044. Gray Bull (upper). X 1.

Planorbis storchi, sp. nov. **17**

17. Apical view of holotype. P. U. No. 20042. Gray Bull (upper) X 1.
18. Basal view of same. X 1.
19. Ventral view of same. X 1.

Polygyra veternior (Cockerell) **19**

20. Apical view of holotype. A. M. N. H. No. 22359. Gray Bull ("Sand Coulée"). X 1.
21. Basal view of same. X 1.
22. Ventral view of same. X 1.
23. Apical view. P. U. No. 20056. Gray Bull ("Sand Coulée"). X 1.
24. Basal view of same. X 1.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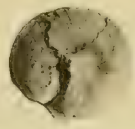
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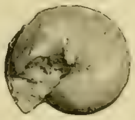
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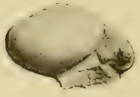
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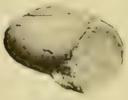
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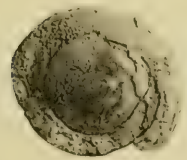
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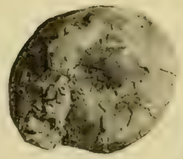
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25. Ventral view of same. X 1.
26. Apical view. P. U. No. 20050. Gray Bull (upper). X 1.
27. Basal view of same. X 1.
28. Ventral view of same. X 1.
29. Basal view. P. U. No. 20050, another specimen. Gray Bull (upper). X 1.

Polygyra eophippina (Cockerell) 20

30. Apical view of holotype. A. M. N. H. No. 22357. Gray Bull ("Sand Coulée"). X 2.
31. Basal view of same. X 2.
32. Ventral view of same. X 2.

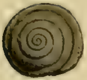
Microphysula sinoparum (Cockerell) 21

33. Apical view of holotype. A. M. N. H. No. 22987. Gray Bull. X 2.
34. Basal view of same. X 2.
35. Ventral view of same. X 2.

PLATE III

Plate 3

Figure	Page
Gastrodonta **coryphodontis** Cockerell	**22**
1. Apical view of holotype. A. M. N. H. No. 22361. Gray Bull ("Sand Coulée"?). X 1.	
2. Basal view of same. X 1.	
3. Ventral view of same. X 1.	
4. Apical view. Princeton University, Dept. of Geology, No. 20057. Gray Bull ("Sand Coulée"). X 1.	
5. Basal view of same. X 1.	
6. Ventral view of same. X 1.	
Oreohelix **megarche** Cockerell and Henderson	**22**
7. Apical view. P. U. No. 20061. Gray Bull ("Sand Coulée"). X 1.	
8. Ventral view of same. X 1.	
9. Basal view of same. X 1.	
10. Apical view. P. U. No. 20065. Gray Bull (upper). X 1.	
11. Ventral view of same. X 1.	
12. Basal view of same. X 1.	
Oreohelix **grangeri** Cockerell and Henderson	**23**
13. Apical view. P. U. No. 20074. Gray Bull ("Sand Coulée"). X 1.	
14. Basal view of same. X 1.	
15. Ventral view of same. X 1.	
16. Ventral view. P. U. No. 20080. Gray Bull (upper). X 1.	
17. Apical view of same. X 1.	
18. Basal view of same. X 1.	
Gonyodiscus **ralstonensis** (Cockerell)	**24**
19. Apical view of holotype. A. M. N. H. No. 22356, said to be from Clark Fork beds, but more probably from lower Gray Bull. X 2.	
20. Basal view of same. X 2.	
21. Ventral view of same. X 2.	
22. Apical view. P. U. No. 20090. Gray Bull (upper). X 2.	
23. Basal view of same. X 2.	
24. Ventral view of same. X 2.	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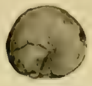
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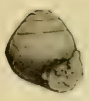
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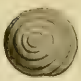
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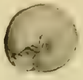
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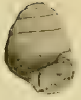
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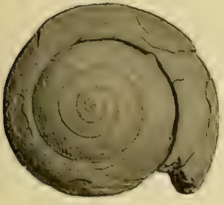
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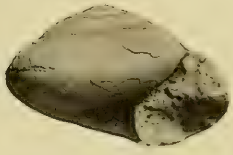
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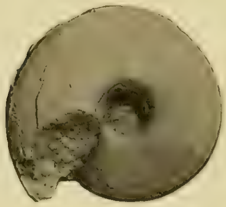
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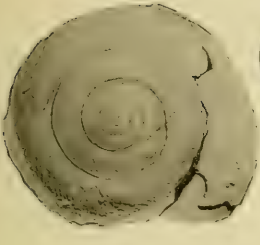
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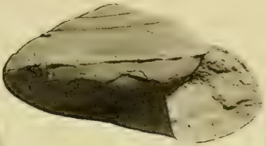
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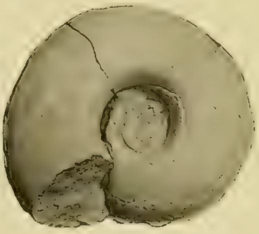
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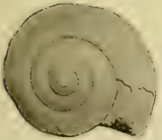
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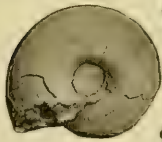
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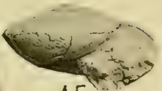
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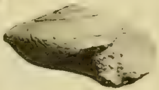
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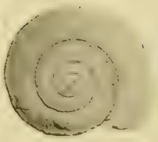
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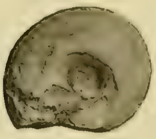
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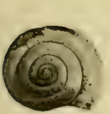
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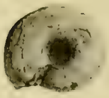
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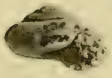
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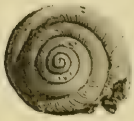
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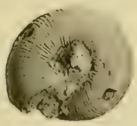
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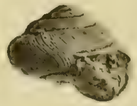
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PLATE IV

Plate 4.

Figure | Page

Grangerella megastoma Cockerell 25

1. Apical view of holotype. A. M. N. H. No. 22256. Gray Bull ("Sand Coulée"). X 2.
2. Basal view of same. X 2.
3. Ventral view of same. X 2.
4. Lateral view of same. X 2.

Grangerella sinclairi (Cockerell) 26

5. Apical view. Princeton University, Dept. of Geology, No. 20099. Gray Bull (upper). X 2.
6. Basal view of same. X 2.
7. Ventral view of same. X 2.
8. Lateral view of same. X 2.
9. Apical view. P. U. No. 20099, smaller specimen. X 2.
10. Basal view of same. X 2.
11. Ventral view of same. X 2.
12. Lateral view of same. X 2.
13. Apical view partly restored. Type of **G. phenacodorum** (Cockerell). A. M. N. H. No. 22254. Gray Bull. X 2.
14. Basal view of same, partly restored. X 2.
15. Lateral view of same, partly restored. X 2.

Protoboysia complicata Cockerell 27

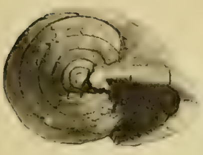
16. Apical view of holotype. A. M. N. H. No. 22255. Gray Bull. X 2.
17. Basal view of same. X 2.
18. Ventral view of same. X 2.
19. Dorsal view of same. X 2.
20. Apical view of topotype. A. M. N. H. No. 22255. Gray Bull. X 2.
21. Basal view of same. X 2.
22. Ventral view of same. X 2.
23. Dorsal view of same. X 2.

Microphysula oxyaenae (Cockerell) 20

24. Apical view of holotype. A. M. N. H. No. 22986. Gray Bull ("Sand Coulée"). X 2.
25. Basal view of same. X 2.
26. Ventral view of same. X 2.

"Eucalodium" eophilum Cockerell 27

27. Ventral view of holotype. A. M. N. H. No. 22257. Gray Bull ("Sand Coulée"). X 1.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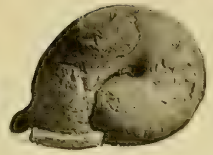
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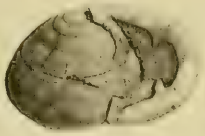
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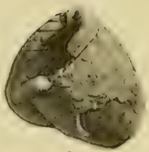
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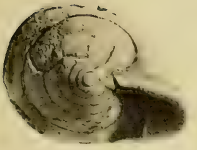
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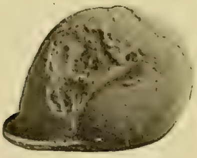
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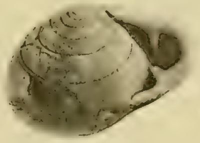
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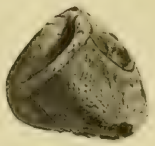
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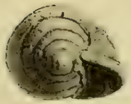
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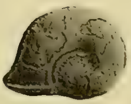
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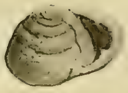
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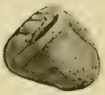
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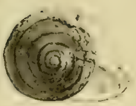
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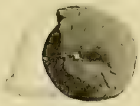
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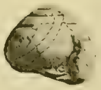
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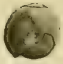
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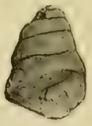
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AUG 2 1937

BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 18

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No. 65

Some New or otherwise Interesting Fossils from the Florida Tertiary

By

H. I. Tucker and Druid Wilson

May 28, 1932

Harris Co.
Ithaca, N. Y.
U. S. A

SOME NEW OR OTHERWISE INTERESTING FOSSILS FROM THE FLORIDA TERTIARY

By

H. I. TUCKER AND DRUID WILSON

(All of the types and other figured specimens are deposited in the collection of the Paleontology Museum at Cornell University. They were collected by the writers in 1928 and 1929.)

Arca æqualitas, n. sp. Pl. 1, fig. 2; pl. 2, fig. 6; pl. 3, fig. 7 and pl. 5, fig. 1

Shell somewhat thicker than typical *A. rustica* Tuomey and Holmes from the Waccamaw of South Carolina. Beaks only slightly elevated, sulcus absent. Auriculation well developed in young specimens. Usually only sixteen ribs. Interspaces deeply excavated, usually same width as interspaces. None of the posterior ribs increase as markedly in width as do those in *A. rustica.* Height 51; width 39 mm.

Specimens in the Cornell Paleontology Museum from Acme, N. C. are apparently related to this species. However, both left valves show a strongly marked sulcus.

Holotype.—Paleont. Mus., Cornell Univ.

Localities.—Port Mayaca, Fla.; Prairie Creek, Fla.; LaBelle, Fla.

Arca acompsa intermediata, n. subsp. Pl. 1, fig. 3

This shell has the form of *A. acompsa* Dall and *A. cercadaca* Maury rather than the form of the *A. lienosa* group. It is flattened and the base is nearly parallel to the hinge. The posterior dorsal margin is not exposed so that it is uncertain whether this character is angular like *A. acompsa* or sinuate like *A. cercadaca.* Practically all the ribs of *A. cercadaca* are divided by a mesial groove and there are few if any secondary grooves. In *A. acompsa* the posterior ribs appear to be undivided. In this shell there are secondary grooves as in the *A. lienosa* group and the distal portions of the posterior ribs show traces of primary and secondary grooves although they are flattened as in *acompsa.* The differences between the Pliocene shell and Dall's *acompsa* may be due to the difference in size and age of the shell. Only two valves of *A. acompsa* Dall have been found and only a left value of *A. cercadata* Maury has been found. At present it seems impossible to determine the exact relationships of these three species. Height 28; width 45 mm.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Acline, Fla.

Arca (Scapharca) chiriquiensis Gabb Pl. 1, fig. 1, 5

1861. *Scapharca chiriquiensis* Gabb, Proc. Acad. Nat. Sci. Phila., vol. 12, p. 567.
1898. *Scapharca* (*Scapharca*) *chiriquiensis* Gabb, Dall, Trans. Wag. Free Inst. Sci., vol. 3, pt. 4, pp. 642-643.
1916. *Arca chiriquiensis* Gabb, Sheldon, Paleont. Amer., vol. 1, p. 49.
1917. *Scaphara* (*Scapharca*) *chiriquiensis* Gabb, Maury, Bull. Amer. Paleont., No. 29, p. 174, pl. 28, fig. 2.
1922. *Arca chiriquiensis* Gabb, Pilsbry, (in part) Proc. Acad. Nat. Sci. Phila., vol. 73, p. 405, pl. 40, figs. 2, 3, 4-6.
1924. *Arca* (*Scapharca*) *chiriquiensis* Gabb, Woodring, Geol. Repub. Haiti, pp. 188, 194, pl. 16, figs. 6, 7, 8.
1925. *Scapharca* (*Scapharca*) *chiriquiensis* Gabb, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 59, pl. 2, fig. 2.

Comparison of our specimens with the large series in the Cornell collections from the Tertiary of South America, showed no important differences. It is rather interesting that *chiriquiensis* should be a fairly common species at Acline, Florida. Height 58, width 69 mm.

Holotype.—Collection Acad. Nat. Sci. Phila.

Localities.—Chiriqui, Central America, Gabb; Santo Domingo, Maury; Haiti, Woodring; Trinidad, Maury; Acline, Fla.

Ostrea haitensis Sowerby Pl. 4, fig. 1

1849. *Ostrea haitensis* Sowerby, Quart. Jour. Geol. Soc. London, vol. 6, p. 53.
1869. *Ostrea veatchia* Gabb, Pal. Cal., vol. 2, p. 34, pl. 11, fig. 59; pl. 17, fig. 21.
1873. *Ostrea haitensis* Sowerby, Gabb, Trans. Am. Phil. Soc., vol. 15, p. 257.
1876. *Ostrea haitensis* Sowerby, Guppy, Quart. Jour. Geol. Soc. London, vol. 32, p. 532.
1898. *Ostrea haitensis* Sowerby, Dall, Trans. Wag. Free. Inst. Sci., vol. 3, pt. 4, p. 685.
1903. *Ostrea haitensis* Sowerby, op. cit. pt. 6, p. 1586.
1906. *Ostrea haitensis* Sowerby, Jou. Koirski and Clerc, Mém. Soc. Phys. et d' Hist. de Genéve, vol. 35, p. 170, pl. 6, figs. 20-23, 32-35.
1917. *Ostrea haitensis* Sowerby, Maury, Bull. Am. Pal., vol. 5, p. 182, pl. 31, figs. 1, 2.
1919. *Ostrea haitensis* Sowerby, Cooke, Carn. Inst., Bull., 291, p. 129, pl. 7, figs. 1, 2; pl. 8, fig. 1.
1920. *Ostrea haitensis* Sowerby, Hubbard, N. Y. Acad. of Sci., vol. 3, pt. 2, p. 99.

Shell quite large, somewhat thick, orbicular in outline; seven or eight coarse, imbricated angular plications with sharp angular furrows between. Large, prominent adductor scar in a posterior central position. Resilifer large. Height 142.5, width 115 mm.

Holotype.—British Museum.

Localities.—LaCruz and Santiago, Cuba, Cooke; Lares Dist., Porto Rico, Hubbard; Bowden, Jamaica, Dall; Chipola of Calhoun County, Fla., Dall; Oak Grove of Santa Rosa County, Fla., Dall; Colorado Desert, Calif., Dall; Acline, Fla.; Buckingham, Fla.

Pecten (Chlamys) interlineatus Gabb Pl. 4, fig. 7

1873. *Pecten interlineatus* Gabb, Trans. Am. Phil. Soc. Phil., vol. 15, p. 256.

1898. *Pecten* (*Chlamys*) *interlineatus* Gabb, Dall, Trans. Wag. Free Inst. Sci., vol. 3, pt. 3, p. 716.

Shell large, rather thin, with about sixteen to twenty low rounded ribs, crossed by concentric wavy rows of eroded lamellæ which are stronger in the interspaces. Shallow interspaces narrower than ribs, each containing a single thread. Submargins narrow, the anterior smooth. Ears unequal, radially sculptured with corrugated threads, notch deep, marked fasciole. Ctenolium consists of 4 or 5 denticles. Interior fluted to umbones. Margins scalloped. Resilial pit shallow, trigonal. Height 53; length 47 mm.

Holotype.—Acad. Nat. Sci. Phila.

Localities.—Oligocene of Santa Domingo, Gabb; Buckingham, Fla.; Naples, Fla.

Pecten (Lyropecten) pittieri floridensis, n. subsp. Pl. 4, fig. 6

Shell large, nearly equivalve, suborbicular, radial sculpture coarse. Left valve somewhat convex, with seven rounded, steep sided, ribs which are sculptured with four or five elevated rounded threads. Three of the ribs are much more prominent and carry concentric rows of small nodes. On the smaller ribs the nodes are much less marked. Flattened interspaces increase markedly in width toward margins and have three to five strong radial threads. Whole surface of shell sculptured with concentric imbricated lamellæ.

Submargins wide, subequal, radially sculptured with scaly threads. Auricles subequal, radially striate, with ten or twelve fine scaly threads. Interior fluted to umbones in harmony with external ribs. Chondrophore, trigonal, deep. Crural ridges strong.

The right valve is similar to the left in sculpture except that the tendency to become nodose seems to be much less marked. Byssal ear radially sculptured with six elevated threads, concentric sculpture of fine lamellæ. Notch narrow, deep, inconspicuous. This subspecies differs from *P. pittieri* Dall in its fewer ribs, flattened interspaces. Evidently *floridensis* is also related to *Pecten* (*aff. Nodipecten*) *colinensis* F. and H. Hodson, from the upper Tertiary of Venezuela. These species are especially interesting because they are apparently intermediate between *Lyropecten* and *Nodipecten*. Height 84; width 87; length of hinge 47 mm.

Locality.—Buckingham, Fla.

KATHOCARDIA, New Subgenus

Shell medium size, inequilateral, somewhat heavy. About 27 ribs which carry high arched lamellæ. Hinge the reverse of typical *Trachycardium* Mörch. Conspicuous pit occurs under the right lateral as occurs also in *C.* (*Trachycardium*) *emmonsi.* The ligament area on the type is longer than in *emmonsi.* The left anterior dorsal margin under the beak resembles a lunule. It is convex, broad, thick. Sculptured with narrow crowded, concentric, sharply elevated lamellæ. Radiating sculpture of shell absent. It is supported internally by a much thickened area. This margin is received by a concave area in the right valve. This subgenus is named in honor of Dr. K. V. Palmer. The type of this genus, *Cardium* (*Kathocardia*) *aclinensis* Tucker and Wilson, is found in the Tertiary of south Florida.

Cardium (Kathocardia) aclinensis, n. sp. **Pl. 3, figs. 1, 2**

Hinge as described above.

Radiating sculpture of about 27 elevated, slightly flattened ribs. Interspaces about same width as ribs. All the ribs crossed by narrow much elevated lamellæ. The lamellæ continue across the interspaces but are elevated only upon the summits of the ribs. Across the first nine or ten anterior ribs the lamellæ form cup-like ornaments while on the last nine or ten posterior ribs the lamellæ form markedly elevated hood-like imbrications. Over the central area of the valve the high arched imbrications tend to be much better developed on the posterior margin of the ribs.

C. aclinensis has a longer ligament area than *C.* (*Trachycardium*) *emmonsi* and the hinge is the reverse of that of typical *Trachycardium*. In *emmonsi* the small convex anterior dorsal area sculptured only by fine crowded lamellæ is developed in the right valve with the corresponding concave area in the left valve. In *aclinensis* this area is in the left valve and the concave area is in the right valve. Dimensions of holotype; Height 59, width 55 mm.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Acline, Fla.

Cancellaria caloosahatchiensis, n. sp. Pl. 1, fig. 4

Shell rather small, thin, about six and a half whorls. Smooth protoconch of one and a half whorls. Spiral and longitudinal sculpture about equally developed on next whorl. Later whorls have stronger widely spaced axial ribs crossed by less strong spiral threads. Interspaces carry numerous fine somewhat unevenly spaced little elevated lines. Spiral ribs form small nodes at shoulder and are absent or less strongly developed across to suture. Shoulders usually carry only a sculpture of fine lines. Younger specimens show marked elevation of shoulder margin. Aperture sub-triangular. Outer lip finely crenulated, somewhat thickened. Three plaits on columella. Holotype: Height, 18 mm.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Ft. Denaud, Fla.

Cancellaria tabulata Gardner and Aldrich Pl. 3, figs. 5, 6

1919. *Cancellaria tabulata* Gardner and Aldrich, Proc. Acad. Nat. Sci. Phila., vol. 71, pp. 23, 24, pl. 1. fig. 9.

Shell rather heavy, large. About five whorls. Protoconch smooth, small. Later whorls increase rapidly in diameter. Elevated spiral threads over-ride irregularly spaced axial ribs and give the shell a somewhat latticed appearance. Spiral sculpture sometimes stronger than axial. Aperture about half the length of the shell. Outer lip internally lirate. Columella carries narrow, oblique, nearly parallel plications.

This species is separated from *C. conradiana* Dall by its much more inflated body whorl, lower spire and its more sharply defined shoulder. Height 25.5 mm.

Localities.—Isle of Wight County, Virginia, Gardner and Aldrich; Acline, Fla.

Cancellaria (Cancellaria) barretti Guppy Pl. 3, fig. 3

1866. *Cancellaria barretti* Guppy, Proc. Geol. Soc. Lon. vol. 22, p. 289, pl. 17, fig. 11.
1874. *Cancellaria barretti* Guppy, Geol. Mag., decade 2, vol. 1, p. 438 (list).
1903. *Cancellaria barretti* Guppy, Dall. Trans. Wag. Free. Inst. Sci., vol. 3, pt. 6, p. 1583 (list).
1921. *Cancellaria barretti* Guppy, Pilsbry & Johnson, Proc. Acad. Nat. Sci. Phil., p. 332.
1928. *Cancellaria* (*Cancellaria*) *barretti* Guyy, Woodring, Carnegie Inst. Pub., 385, pt. 2, p. 219, pl. 12, fig. 6.
Not *C. barretti* Guppy, Maury, 1917, Bull. Am. Pal. vol. 5, pp. 226-227, pl. 36, fig. 1; Pilsbury, 1922, Proc. Phil. Acad. Nat. Sci. vol. 73, pp. 332-333. *C. Mauryœ* Olsson.
Not *C. barretti* Olsson, 1922, Bull. Am. Pal., vol. 9, p. 253, pl. 9, fig. 6 (?-C. dariena Toula).

Specimens from Costa Rica identified as *C. barretti* by Olsson (Bull. Am. Pal. vol. 9, p. 253, pl. 9, fig. 6) and by many from Santa Domingo (Bull. Am. Pal. vol. 5, pp. 226-227, pl. 36, fig. 1) are apparently not this species. Woodring reports it from the Bowden Miocene, Jamaica and from the Cercado formation of Santa Domingo. Our adult specimen appears identical with his figure (Carnegie Inst. Pub. 385, p. 219, pl. 12, fig. 6). Guppy's figure evidently represents an immature specimen.

C. barretti appears to be closely related to *C. conradiana* and *C. reticulata.* It differs from *conradiana* chiefly in the position and form of the columellar plaits and in the relative length of the aperture. In *conradiana* the aperture is about half the length of the shell while in *barretti* it is nearly two thirds that of the shell. *C barretti* resembles *conradiana* very closely in shape but is less slender. The upper columellar plait is usually not bifid in *conradiana.* The spiral sculpture in *conradiana* is stronger than in *barretti* and the secondaries are usually absent. The body whorl of *barretti* is much more inflated than in *conradiana*. *C. barretti* is smaller than *reticulata*, more slender, sculpture much less coarse; callus slightly heavier; upper columellar plait bifid. The length of the aperture of *reticulata* is about half that of the shell. *C. barretti* is much more sharply angulated at the suture than *reticulata*. Length 36.5, width 21 mm.

Holotype.—British Museum, Natural History, Geological Department, No. 64069.

Localities.—Cercado formation, Santo Domingo, Maury; Bowden, Jamaica, Woodring; Moore Haven, Fla., LaBelle, Fla.; Okechobee City, Fla.; Acline, Fla.

Cancellaria (Cancellaria) venusta Tuomey and Holmes Pl. 4, fig .2

1857. *Cancellaria venusta* Tuomey and Holmes, Pleio. Fos. S. Car., p. 144, pl. 28, fig. 18. Not of Holmes, 1860.
1890. *Cancellaria venusta* Tuomey and Holmes, Dall, Trans. Wag. Free Inst. Sci., vol. 3, pt. 1, p. 43, pl. 3, fig. 12.
1919. *Cancellaria venusta* Tuomey and Holmes, Gardner and Aldrich, Proc. Acad. Nat. Sci. Phil., vol. 71, p. 17, (list).

Shell subfusiform, turrited, rather large, somewhat thick. Five and a half rounded whorls. Smooth, flat, protoconch of about one and a half whorls. Succeeding whorl carries only spiral sculpture. On later whorls, axial lines intersect spirals forming nodes which give the shell a cancellate appearance. This tendency becomes more marked on the inflated body whorl. In young specimens the cancellation is more marked. Young specimens are much more slender than adults. In one young specimen from Prairie Creek, Fla., the longitudinal ribs noted by Tuomey and Holmes are developed. An adult shell from the Pliocene of Acme, N. C., shows strongly developed cancellate sculpture. Aperture markedly ear-shaped, about one half length of shell. Two strong plications on columella, anterior one somewhat more oblique. Canal short, rather wide, slight callus, Umbilicus present. Outer lip marked within by nine or ten lirations. Young specimens are much more slender than adults.

Range.—Miocene-Pliocene.

Localities.—Muldron Place, Sumter County, S. Car., Gardner & Aldrich; Waccamaw, S. Car., Tuomey and Holmes;

Prairie Creek, Fla.; Acme, N. C.; LaBelle, Fla.; Moore Haven, Fla.

Fasciolaria okeechobensis, n. sp. **Pl. 1, fig. 6**

Shell thin, smaller than *F. tulipa* Linnaeus. Protoconch smooth, first two apical whorls spirally and longitudinally sculptured, all lateral whorls carry strong irregular elevated spiral threads. Subsutural ridges stong and slightly appressed.

This species differs from *F. tulipa* Linnaeus in having the first apical whorls both spirally and longitudinally grooved, in being somewhat less appressed in front of the suture and in being more slender. Length 58, width 28 mm.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Port Mayaca, Fla.

Melongena consors Sowerby **Pl. 2, fig. 1**

1849. *Pyrula consors* Sowerby, Quart. Jour. Geol. Soc. London, vol. 5, p. 49.
1873. *Melongena Melongena* Linnaeus Gabb, Trans. Am. Phil. Soc., vol. 15, p. 205, Not of Linnaeus.
1874. *Pyruta melongena* Linnaeus, Guppy, Geol. Mag., vol. 11, p. 438.
1876. *Pyrula melongena* Linnaeus, Guppy, Quart. Jour. Geol. Soc. London, vol. 32, p. 523.
1900. *Melongena consors* Sowerby, Dall, Trans. Wag. Free Inst. Sci., vol. 3, pt. 1, p. 121.
1917. *Melongena consors* Sowerby, Maury, Bull. Am. Pal. vol. 5, p. 249, pl. 14, fig. 5.
1922. *Melongena consors* Sowerby, Olsson, Bull. Am. Pal., vol. 9, p. 284, pl. 9, fig. 1.

M. consors is not a common fossil in the Caloosahatchie. It is related to the recent *M. corona* Gmelin from which it differs in having a higher spire and somewhat different sculpture above. The number of rows of tubercles varies in *consors*. Some specimens show none, others may have one, one and one half, two or three rows, in a series. The tubercles may be close to each other or distant. The Costa Rican specimens are not common and are exactly like the Santa Domingo Miocene forms. Height 113, length 75 mm.

Localities.—Bowden, Jamaica, Olsson; Costa Rica, Olsson; Santa Domingo, Maury; Okeechobee City, Fla.

Solenosteira mengeana caloosana, n. subsp. **Pl. 3, fig. 4**

This subspecies differs from *S. mengeana* Dall in the absence of ribs on the body whorl and in the somewhat stronger development of narrow, sharply elevated spiral cords. Sometimes there is one or more feebly developed secondary spiral in the interspaces. Growth lines strongly developed. Last two whorls flattened in front of the suture. Height 25; width 17; length of aperture 19 mm.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Prairie Creek, Fla.

Solenosteira vaughani aclinensis, n. subsp. Pl. 2, figs. 7, 8

The specimens from Acline differ from the type in having less coarse spiral cords, in being more slender and more produced, in having more sloping shoulders and less strong axial ribs and a higher spire.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Acline, Fla.

Colubraria floridensis, n. sp. Pl. 4, figs. 3, 4

Shell small, elongate, slender. Nucleus of about one and three-fourths smooth, rapidly enlarging whorls; subsequent whorls six, with eleven varices at irregular intervals. Whorls transversely sculptured with distantly spaced ribs which are not parallel with the growth lines but curve strongly forward towards the base of the shell. Spiral sculpture of about seventeen primary threads, interspaces crowded usually with a single secondary alternating with two tertiaries; all over-ride the ribs and varices. Towards the base of the shell all threads are equal in size and become obsolete. A young shell has stronger sculpture and on the body whorl shows a tendency to nodulation at the suture. The aperture is slender with a weak siphonal notch; anterior canal sharply recurved; columella smooth, outer lip varicose with edge obsoletely denticulate, inner lip smooth. Length 20 mm; width 7 mm; aperture 9 mm.

The spire of *C. floridensis* does not present the eccentric appearance of some of the species of this genus.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Prairie Creek, Fla.

Cassis floridensis, n. sp. Pl. 2, figs. 2, 5; pl. 5, fig. 2

Shell medium sized, heavy; spire low; aperture long, narrow, anteriorly deeply emarginate. Columella and outer lip strongly plicate for entire length. Outer lip has ten plications, columella fifteen. Inner and outer lips greatly thickened; protoconch about three smooth whorls. Next whorl spirally sculptured. Following whorls of spire and body whorl axially and spirally sculptured giving shell a somewhat cancellate appearance. Axial sculpture regular and stronger than spiral. Strong axial sculpture gives shell a somewhat noded appearance at the shoulder. Height 30.5; width 22 mm.

This species seems to be quite different from any thus far reported. It may be a young shell but comparison with species occuring in the Tertiary of the West Indies and the southern United States leaves little doubt that it is a new species.

Holotype.—Paleont. Mus., Cornell Univ.

Locality.—Acline, Fla.

Cypraea carolinensis floridana Mansfield, n. sp. Pl. 5, figs. 4, 5

1931. *Cypraea carolinensis floridana* Mansfield, U. S. Nat. Mus. Proc., vol. 79, p. 6, pl. 1, figs. 2, 6, 7.

Shell somewhat heavy, inflated, rather elongated, smooth, slightly flattened ventrally. Spire concealed. Aperture curved, much wider below. Outer lip well raised above the spire, inner lip less elevated and separated above by a wide curved canal. Anteriorly the columella and outer lip are somewhat flattened. Denticulations increase markedly in strength anteriorly on the columella and outer lip. Canal somewhat ovate.

This species differs from *C. carolinensis* Conrad in having the columella and outer lip much flattened and produced. Ventrally *carolinensis* is flattened and the canal is rounded. Inner and outer lips less elevated above the spire in *carolinensis.* Length 78; width 41 mm.

Holotype.—U. S. Nat. Mus., Washington, D. C.

Locality.—42 miles from Miami, Fla., Mansfield; Acline, Fla.

Triva incerta, n. sp. Pl. 2, figs. 9, 10

Shell small, thin, inflated. Striæ extend farther dorsally on the left of the shell. On the right the sculpture of fine longitudinal lines replace the striæ. Spire consists of about four smooth whorls. Outer lip wide, elevated posteriorly. Curved aperture extends length of shell and expands anteriorly. Outer lip denticulate. Columellar furrow marked.

This species is apparently quite distinct from any thus far collected from the Caloosahatchie Pliocene. However, it may prove to be a pathologic specimen, or the young of some undescribed species. Length 7.5; width 4.25 mm.

Holotype.—Paleont. Lab., Cornell Univ.

Locality.—Moore Haven, Fla.

Cyphoma gibbosa Linnaeus Pl. 5, fig. 7

1758. *Bulla gibbosa* Linnaeus, Syst. Nat. ed. 10, p. 726.
1865. *Ovulum gibbosum* Linnaeus, Reeve, Conch. Icon. vol. 14, pl. 7, fig. 32a, 32b.
1885. *Ovula gibbosa* Linnaeus, Tryon, Nat. Conch. vol. 7, p. 250, pl. 3, figs. 21, 82.
1889. *Ultimus gibbosus* Linné, Dall, U. S. Nat. Mus. Bull. 37, p. 134.
1901. *Ultimus gibbosus* Linné, Dall and Simpson, Bull. U. S. Fish Com. vol. 1, p. 420.
1922. *Cyphoma gibbosa* Linnaeus, Maury, Bull. Am. Pal. 38, pt. 2, p. 82.

Shell thick, oblong, smooth, polished, narrower above, wider below. Spire concealed by heavy callus, conspicuous elevated transverse dorsal rib. Columella smooth, thick, slightly truncated below. Outer lip smooth, very thick, slightly arched over upper end of shell. Aperture as long as shell. Length 31.5 mm; width 16.5 mm.

Localities.—Mayaguez Harbor, Porto Rico, Dall & Simpson; Florida Keys, Dall & Simpson; Georgia to Trinidad, 15-50 fms., also west Florida, Maury; Port Mayaca, Florida.

Natica guppyana Toula Pl. 2, figs. 3, 4

1909. *Natica guppyana* Toula, Jahrb der K-K. Geol. Reichsanstalt, Wien, vol. 58, p. 696, pl. 25, fig. 6.
1911. *Natica guppyana* Toula, Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 360.
1922. *Natica guppyana* Toula, Olsson, Bull. Am. Pal., vol. 9, No. 39, p. 156, pl. 13, figs. 13, 14, 15.
1928. *Natica (Stigmaulax) guppvana* Toula, Woodring, Carnegie Inst. Wash. Pub. 385, p. 383.

The sculpture of *N. guppyana* Toula consists of fairly deep, wide sulcations extending across the whorls from the upper suture to the umbilicus. These sulcations are less well developed in the middle of the last whorl. Height 14; width 13 mm.

This species has been reported from the Miocene of Santa Domingo, Jamaica, Venezuela and Costa Rica. It seems never to have been reported before from the United States.

Localities.—Gatun formation of Panama and Costa Rica, Olsson; Bowden of Jamaica, Woodring; Acline, Fla.

Turbo crenulatoides Maury Pl. 5, fig. 3

1866. *Cf. Turbo custaneus* Guppy, Quart. Jour. Geol. Soc. London, vol. 22, p. 291.
1874. *Cf. Turbo castaneus* Guppy, Geol. Mag. London, p. 441.
1903. *Cf. Turbo* near *crenulatus* Gmelin, Dall, Trans. Wag. Free Inst. Sci. vol. 3, pt. 6, p. 1585.
1917. *Turbo crenulatoides* Maury, Bull. Am. Pal., vol. 5, pt. 1, p. 153, pl. 24, fig. 14.

The somewhat worn paratype shows a tendency to become slightly nodular on basal spirals. The last three spirals on the base are equally strong on the paratype while on our adult specimens from Port Mayaca, Florida, the spirals alternate in strength and are distinctly nodular. Younger specimens from LaBelle, Florida, resemble the holotype very closely in sculpture, having the last four basal spirals equal in strength and somewhat squamose. Length 19; width 15 mm.

Holotype.—Paleont. Lab., Cornell Univ.

Localities.—Zone B. Rio Gurao; Zone H, Rio Cana, Santa Domingo, Maury; LaBelle, Fla.; Port Mayaca, Fla.

Dorsanum ? plicatile (Böse) Pl. 5, fig. 6

1906. *Cominella plicatilis* Böse, Institut Geologico de Mexico, Bol. 22, p. 39, pl. 4, figs. 22, 24.
1929. *Dorsanum ? plicatilum* (Böse), Cooke and Mossom, Twentieth Ann. Rept. Fla. Geol. Surv., pl. 16, fig. 3.
1930. *Dorsanum ? plicatilum* (Böse), Mansfield, Bull. Fla. Geol. Surv., No. 3, p. 73, pl. 17, fig. 3.

Cossman (Essais Pal. Comp., vol. 4, p. 220, 1901) refers *"Buccinum" veneris* Faujas to the genus *Dorsanum. D. plicatilum* appears to be most nearly related to *B. veneris.* Mansfield (Bull. Fla. Geol. Surv., No. 3, p. 73) considers that it lies between *Ptychosalpinx* and *Alectrion.*

Localities.—Paso Real cerca de Tuxtepec, Oaxaca, Böse; Harveys Creek, Leon County, Fla., Mansfield; Near Jackson Bluff, Leon County, Fla., Mansfield; Acline, Fla.

Phos floridensis, n. sp. Pl. 4, fig. 5

Shell medium sized, solid, inflated, with about seven whorls, surface strongly sculptured. Protoconch? First six rapidly enlarging whorls sculptured by strong, rounded axial ribs which continue across each whorl and by strong sharply elevated spiral threads which over-ride the ribs and descend into the interspaces Each primary spiral, after the third apical whorl, has from one to three secondaries parallel to it. Axial ribs less strongly developed on body whorl. Lines of growth clearly defined. Aperture moderately wide, forming a short, wide recurved canal. Outer lip has about seven strong entering liræ. Strong fold at base of columella followed by a groove and a slight swelling. Inner lip has above six feeble liræ. Length 30; width 26; length of aperture 15 mm.

This species is distinguished from *P. intricatus* Dall by its larger size, heavier shell, litrations on the inner lip, strong fold at base of columella and by the continuation of spiral and axial sculpture over the entire whorls. In *P. intricatus* the shoulders have no spirals.

Holotype.—Paleont. Lab., Cornell Univ.

Locality.—Prairie Creek, Fla.

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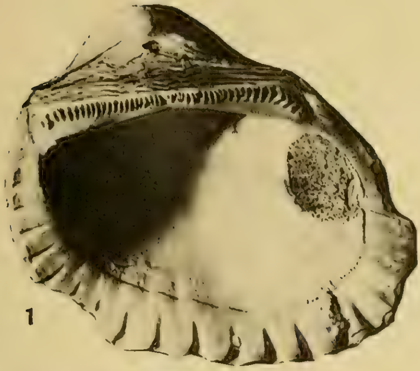
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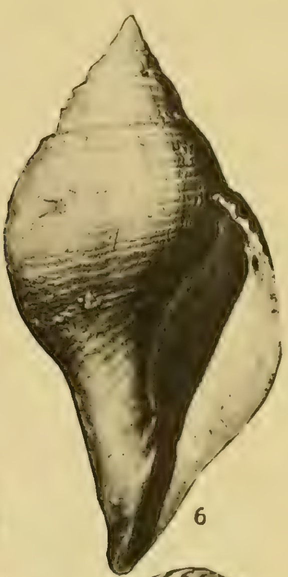
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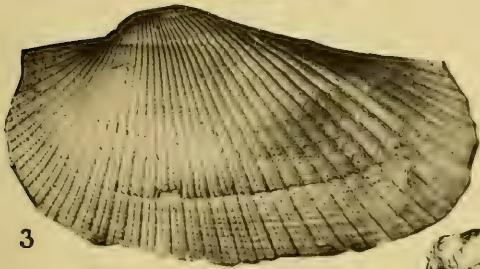
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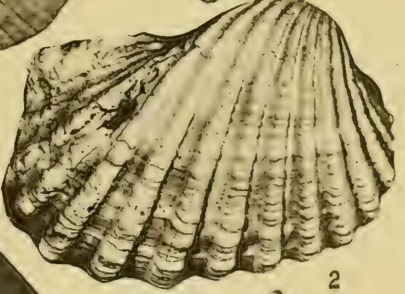
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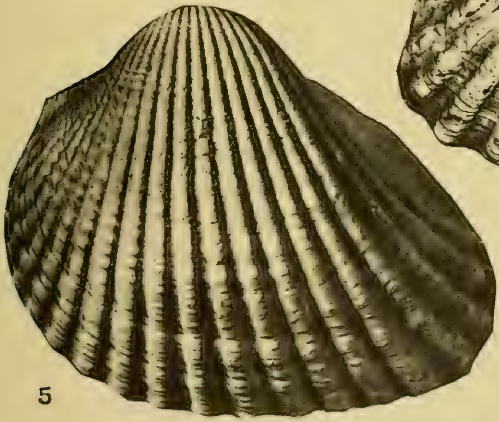
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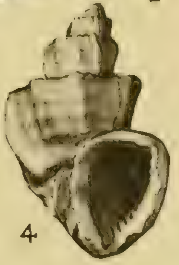
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PLATE 2

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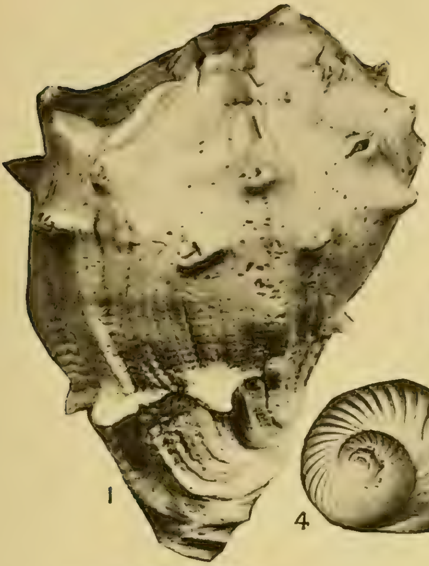
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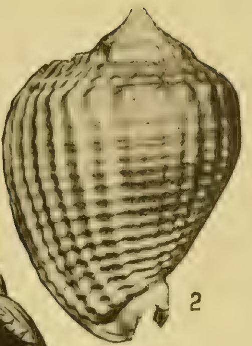
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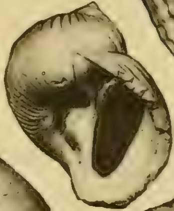
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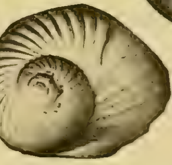
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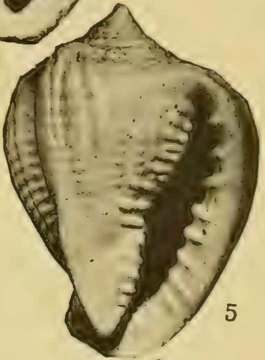
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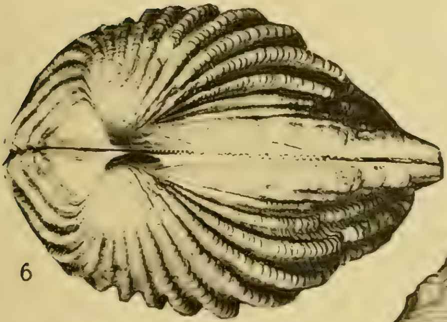
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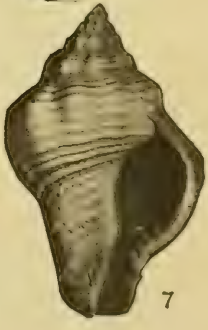
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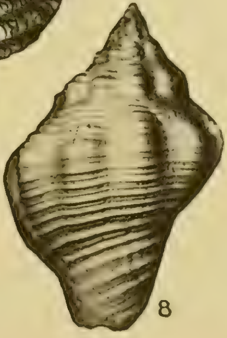
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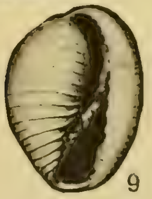
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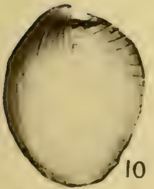
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PLATE 3

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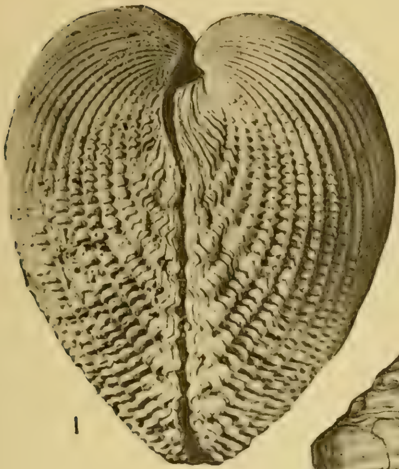

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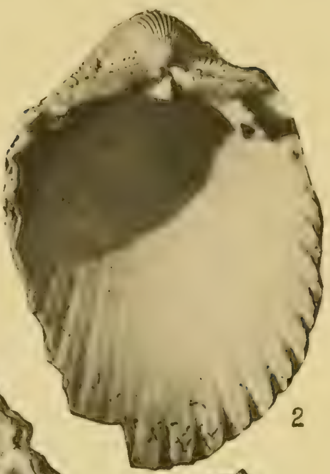

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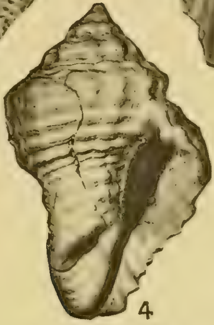

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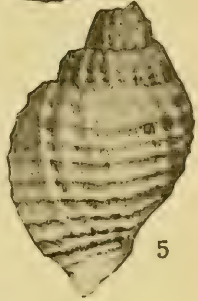

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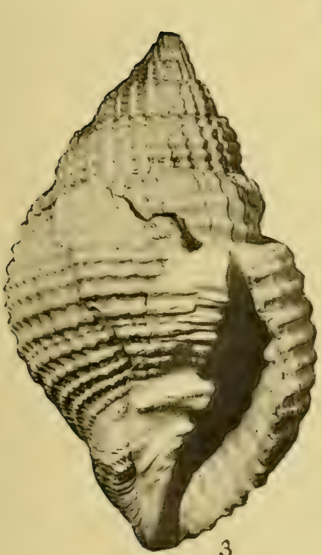

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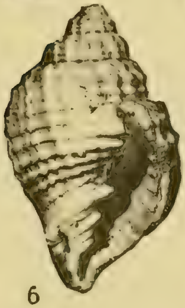

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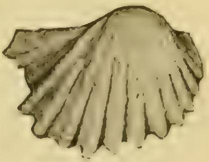

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Plate 4.

Plate 4

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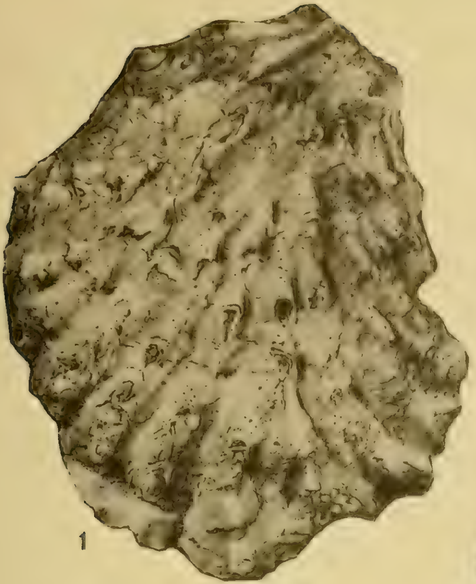
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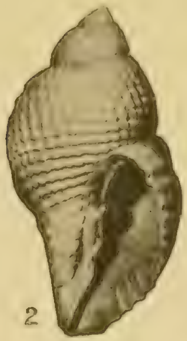
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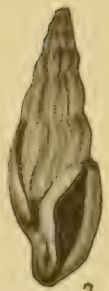
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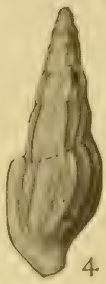
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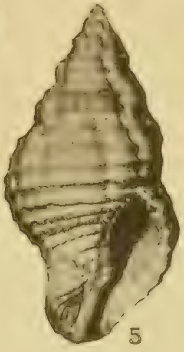
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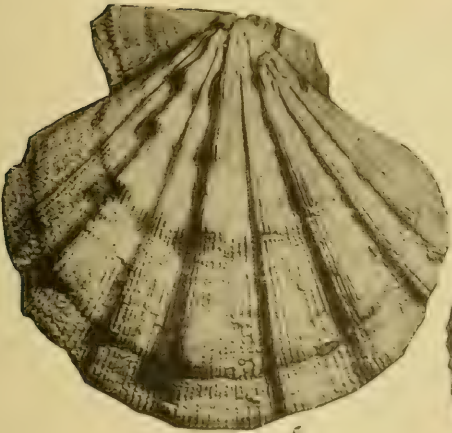
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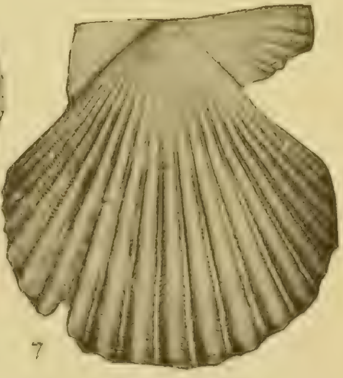
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PLATE 5

PLATE 5

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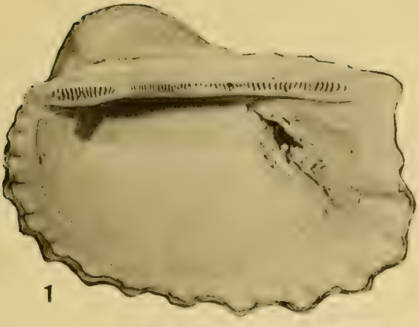
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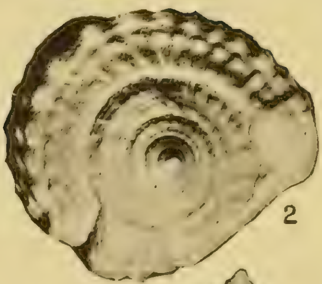
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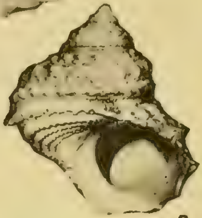
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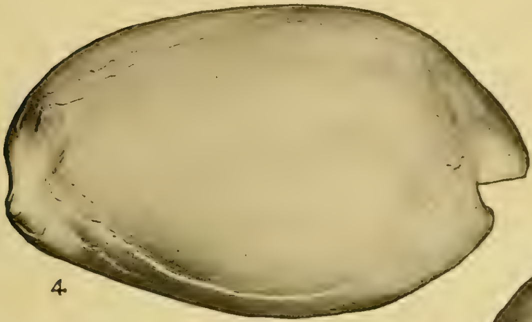
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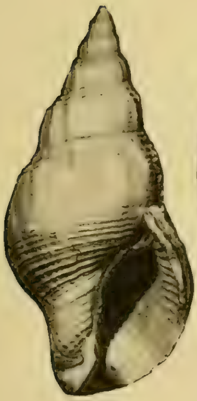
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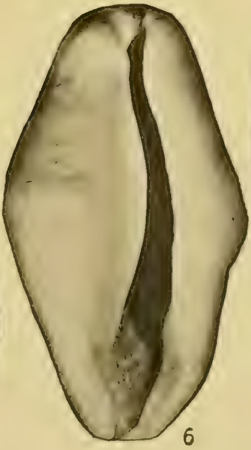
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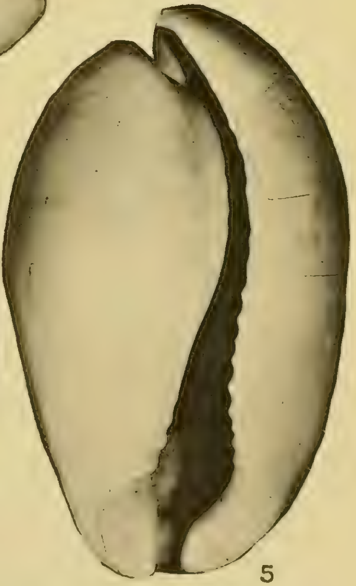
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BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 18

*

No. 66

A Second Contribution to the Neogene Paleontology of South Florida

By

H. I. Tucker and Druid Wilson

June 3, 1933

Harris Co.
Ithaca, N. Y.
U. S. A.

A SECOND CONTRIBUTION TO THE NEOGENE PALEONTOLOGY OF SOUTH FLORIDA[1]

BY H. I. TUCKER AND DRUID WILSON

Barbatia (Acar) aclinensis Tucker and Wilson, n. sp.[2]
Pl. 1, figs. 6; pl. 2, figs. 5, 9

> *Arca (Barbatia) aclinensis* Tucker and Wilson, 1931, Proc. Ind. Acad. Sci., vol. 41, p. 357 (list).

Shell very thin, small. Surface radially sculptured with elevated, beaded threads. On the anterior side of the shell are fine interstitial threads which become especially strong on the sinus. On the two young specimens the primary ribs are divided except on the posterior slope where they are entire and closely set.

Dimensions of holotype.—Height, 14 mm., width?

This species is separated from *A. millifila* Dall by the closely set, divided ribs.

Age.—Miocene ? - Pliocene.

Locality.—Acline, Fla. (type locality). Prairie Creek, Fla.

CASTERIA, Tucker and Wilson, n. subgen.

Shell somewhat thickened, aviculoid; valves slightly and nearly equally convex, rounded, posteriorly auriculate. Marked anterior byssal gape. Hinge long, edentulous. Ligament bears fourteen to fifteen wide parallel grooves perpendicular to the dorsal margin. Interior nacreous. The type of this subgenus is *Pedalion (Casteria) kecia* Tucker and Wilson which occurs in the Pliocene of south Florida.

Casteria differs from *Isognomon* Solander (See Reeve, vol. 13, pl. 5, fig. 24), in being more nearly equivalved; in having smaller auricles; and in being much less produced.

Pedalion (Casteria) kecia Tucker and Wilson, n. sp. Pl. 2, figs. 3, 4

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[1] See Bull. Am. Pal., vol. 18, no. 65, May, 1932 for the first contribution.

[2] All holotypes and figured specimens are deposited in the Cabinet of the of the American Paleontological Institution.

Hinge and general appearance of the shell as described above. Surface sculputred by strong concentric, little elevated growth lines which indicate that the outline of the shell is somewhat rounded.

This species has been found only at Acline and is represented by incomplete right and left valves and a few fragments. Since *Pedalion* is so rare in the Atlantic Coast Tertiary it seems worth while to figure and describe this apparently distinct form.

Pedalion has been reported from the Midway Eocene of Alabama, (*Perna cornelliana* Harris, 1896, Bull. Am. Pal., vol. 1, p. 162, pl. 3, figs. 2, 3.), and from the Oak Grove of Florida, (*Pedalion solerepta* Maury, 1910, Bull. Am. Pal., vol. 4, no. 21, p. 33, pl. 8, fig. 8). Maury's description is quoted by Gardner, U. S. G. S. Prof. Paper, 142-A, p. 39. None of these shells is similar to our species in hinge structure or general outline of the shell.

Woodring reports a species of *Isognomon*, (Pub. Carnegie Inst., 1925, no. 366, p. 58, pl. 16, fig. 10) which differs markedly from our shell in hinge structure and in the character of the byssal gape.

P. eppihippum Lamarck is more flattened and tends to be more triangularly orbicular in outline than our shell.

Dimensions of holotype.—Width 54, length of hinge line 38.5 mm.

Age.—Miocene ?

Locality.—Acline, Fla.

Pecten ernestsmithi Tucker Pl. 2, fig. 13

Pecten ernestsmithi Tucker, 1931, Proc. Ind. Acad. Sci., col. 40, p. 244, pl. 1, figs. 2, 3.

Shell ovate, rather large, heavy, with five ribs, three of which are better developed. The ribs are broad and rounded on their summits and show a marked tendency to become nodose from the umbonal region to the periphery. Interspaces wider than the ribs and deeply channeled. Both ribs and interspaces strongly, radially threaded. A fragment of a right valve shows a strongly developed, concentric sculpture of scaly lamellæ over both ribs and interspaces. Beak narrow and quite pointed. Sub-margins narrow, the outer margins nearly smooth, the inner radially threaded like the rest of the disk. Ears large, unequal and radially threaded. Anterior byssal ear quite pointed and somewhat corrugated along the cardinal margin. Posterior ear somewhat less strongly threaded. Byssal sinus deep, narrow and inconspicuous. Fasciole broad. Interior fluted to the umbones. Margins crenulated. Ctenolium consists of six, prominent denticles. Resilial pit narrow, trigonal, lateral margins elevated. Cardinal margin of the right valve bent over the left. Provinculum strongle developed. Valve retains traces of a blochy color pattern. Height 85, lenght 82.5, length of hinge line 60 and convexity about 20 mm.

This species differs from *P. caloosaënsis* Dall in the shape of the ears, in the width of the interspaces and in sculpture. *P. ernestsmithi* shows a well developed sculpture of radial threads while in *caloosaënsis* the interspaces are sculptured only with feeble concentric lines. The anterior byssal ear of *ernestsmithi* is much more pointed at the cardinal margin than that of *caloosaënsis.*—Tucker.

P. ernestsmithi Tucker is represented in the Caloossahatchie collections only by fragments. It is apparently not at all a common shell in the Florida Pliocene.

Age.—Pliocene.

Locality.—Acme, N. C., Tucker. Moore Haven, Fla.

Placunanomia aclinica Tucker and Wilson, n. sp. Pl. 4, figs. 8, 9

Form and general appearance as indicated by the figures.

The left valve of *P. aclinica* is concave in the umbonal region and is sculptured by growth lines. Ventral margin bears two broad deep folds with a less strong one on either side. The large triangular umbonal depression into which the crura are received indicates that the crura diverged at a wide angle.

Dimensions of holotype.—Height 68, width 55 mm. Only one specimen in hand.

P. lithobleta Dall differs from our species in having radial sculpture. *P. plicata* Tuomey and Holmes has only slightly divergent crura while in *aclinica* they diverge at a wide angle. Our species is concave in the umbonal region while *plicata* is flat.

Age.—Miocene ?

Locality.—Acline, Fla.

Cardita (Carditamera) aclinica Tucker and Wilson, n. sp. Pl. 1, fig. 2

Shell large, more produced posteriorly than *C. vaughani* Dall. Usually sixteen broad, flat-topped ribs which are sculptured with regular, wide concentric, raised threads. Anteriorly the threads tend to be somewhat wavy. Interspaces slightly angular, somewhat wider than the ribs, sculptured only by growth lines. Posterior side of the ribs overhang the interspaces in the middle of the valve. Posterior lateral strong.

Dimensions of holotype.—Height 20, length 44 mm. Largest specimen measures: Height 28, length, 55 mm. A specimen of *C. vaughani* from Jackson Bluff measures: Height 28, length 38 mm.

C. tamiamiensis Mansfield has much less flat, more closely spaced, narrower ribs than *aclinica*. The concentric sculpture of *tamiamiensis* is apparently more strongly elevated.

Age.—Miocene ?

Locality.—Acline, Fla.

Tellina interrupta Wood Pl. 1, fig. 1

Tellina interrupta Wood, 1815. Gen. Conch. Dall, 1889, U. S. Nat. Mus. Bull., 37, p. 60; Maury, 1924, Bull. Am. Pal., vol. 8, p. 110.

Shell slender, subequilateral, elongate. Beaks nearly at the center of the shell. Anterior side long, dorsal margin nearly straight, extremity rounded. Posterior side narrower, produced. The left valve having a sinus, the right a fold. Ventral margin rounded. Surface sculptured with thin, elevated, concentric lamellæ which become much stronged on the anterior and posterior portions of the shell. Whole surface sculptured by very fine radiating threads which override the lamellæ, giving them an obscurely beaded appearance.

Dimensions of figured specimen.—Height 10, width 23.5 mm.

Recent specimens from St. Thomas have only obscure radiating threads and are much more convex than the Florida fossils. Recent specimens from Florida differ from the Pliocene specimens only in greater convexity of the valves.

Age.—Miocene ? - Recent.

Locality.—North Carolina to Brazil, Maury. Gulf Coast of Florida, Maury. Ft. Denaud, Fla. Port Mayaca, Fla. Acline, Fla.

Astralium americanum Gmelin Pl. 3, figs. 1, 4

Astralium americanum Gmelin, 1792. Syst. Nat., p. 3581; Pilsbry, 1888, Tryon Man. Conch., 1st. ser., vol. 10, p. 224, pl. 52, figs. 18-20; Dall and Simpson, 1900, Bull. U. S. Fish Comm., vol. 1, p. 442.

Shell trochiform, imperforate, heavy, conical, with about seven whorls. Sutures well marked. Whorls longitudinally, obliquely plicate with often slightly curved ridges which sometimes terminate in nodules at the periphery. Base flattened, with about six to eight elevated scaly cords. Aperture oblique, outer lip crenulated.

Dimensions of figured specimen.—Height 29, diameter 28 mm.

Age.—Pliocene - Recent.

Locality.—Port Mayaca, Fla.

Turbo wellsi Tucker and Wilson, n. sp. Pl. 2, fig. 10

Shell imperforate, rather high spired, callus fairly heavy, aperture broken back. Flat, smooth nucleus of about one and a half whorls followed by four spirally sculptured whorls. Strong beaded spiral borders slightly excavated suture. Third and fourth whorls carry two additional beaded threads at the suture, of which the second is the smaller. On the body whorl are two heavy beaded spirals with one very fine beaded thread in the interspace. Later secondary threads not beaded or only obscurely so; heavier. Four heavy, prominent plain spirals on body whorl. On base are four closely spaced, beaded spirals of about uniform size followed by a stronger plain cord.

Dimensions of holotype.—Height 21, diameter 17 mm.

Specimens of *T. dominicensis* Gabb from the Bowden differ from *wellsi* in having strongly, closely spaced, beaded spirals of approximately uniform size over the body whorl and base of the shell.

Age.—Pliocene.

Locality.—Ft. Denaud, Fla. Moore Haven, Fla.

Polinices subclausa Sowerby Pl. 2, fig. 7

Natica subclausa Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 51; Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 18, fig. 8.

Polinices subclausa Sowerby, Brown and Pilsbry, 1911, Proc. Phila. Acad. Sci., vol. 63, p. 360; Maury, 1917, Bull. Am. Pal., vol. 5, p. 300, pl. 23, fig. 14; Olsson, 1922, Bull. Am. Pal., vol. 9, p. 157, pl. 13, figs. 16, 17.

A somewhat worn specimen from Acline strongly resembles the Costa Rican specimens figured by Olsson. It is slightly more inflated at the shoulders, but carries the characteristic transverse groove on the callus near the upper edge of the umbilicus.

Dimensions of figured specimen.—Height 15 mm.

Age.—Miocene - Pliocene?

Locality.—Banana River, Costa Rica, Olsson. Santo Domingo, Maury. Acline, Fla.

Polinices floridana Tucker and Wilson, n. sp. Pl. 2, fig. 1

Shell solid, somewhat subovate in outline, rather large. Umbilicus wide, central; funicle central, strong. Umbilical callus absent. Heavy parietal callus has strong transverse groove.

Dimensions of holotype.—Height 17.5, diameter 17 mm.

P. caroliniana Conrad (A. J. S., 1st. ser., vol. 41, pl. 2, fig. 18) differs from this species in having no transverse groove on the parietal callus and in having a sculpture of obsolete spiral lines. The umbilicus of *floridana* is wider than in *P. subclausa* Sowerby (see pl. 2, fig. 7) and the funicle is stronger.

Age.—Pliocene.

Locality.—Ft. Denaud, Fla.

Natica (Natica) castrenoides Woodring Pl. 2, fig. 2

Natica (Natica) castrenoides Woodring, 1928, Pub. Carnegie Inst. Washington, no. 385, pt. 2, p. 377, pl. 30, fig. 5.

Shell small, spire moderately low. Nucleus consisting of about one and a half whorls, the apical one large. Funicle bulge on umbilical wall. Sculpture consisting of obscure wrinkles that are most prominent near the suture.—Woodring.

Dimensions.—Height 10, diameter 10.5 mm.

Age.—Miocene (Bowden) - Pliocene?

Locality.—Bowden, Jamaica, Woodring. Acline, Fla.

Strombus mayacensis Tucker and Wilson, n. sp. Pl. 1, fig. 7; pl. 3, figs. 3, 5

Outline and sculpture as indicated by figures.

Sutures markedly appressed in young specimens (pl. 1, fig. 7). Spire higher than in *S. leidyi* and more slender. Outer lip more rounded and flattened at the shoulder than of *S. inermis* Swainson (see pl. 3, fig. 2) and it extends higher up the spire. This species usually does not have the nodes extending entirely across the outer lip.

Dimensions of holotype.—Height 167.5, diameter 116 mm.

Age.—Pliocene.

Locality.—Port Mayaca, Fla.

Colubraria aclinica Tucker and Wilson, n. sp. Pl. 2, fig. 14

Shell small, whorls somewhat inflated, sutures impressed. Early whorls? Spiral sculpture of about eight or nine primary threads, interspaces on body whorl have a less strong secondary between weak tertiary threads. On the whorls of the spire only the single secondary is present. Axial threads about the same size as the primary spirals. At their intersection they form low beads. Axials become obsolete toward the base. Aperture slender; margin of the inner lip elevated to form a thin lamella. Outer lip varical, internally carries faint lirations arranged in pairs. Anterior canal sharply recurved; columella smooth.

Dimensions of holotype.—Height 14, diameter 5 mm.

This species differs from *C. floridana* Tucker and Wilson (Bull. Am. Pal., vol. 18, no. 65, p. 11, pl. 4, figs. 3, 4) in not having strong axial ribs as well as in the character of the spiral sculpture.

Age.—Miocene ?

Locality.—Acline, Fla.

Morum floridana Tucker and Wilson, n. sp. Pl. 1, figs. 3-5

Shell somewhat triangular in outline, tuberculated. Nuclear whorls smooth, mucronate. Succeeding whorls of spire flattened. Body whorl has six strongly tuberculated axial ribs which are crossed by spiral threads of unequal strength. Weak growth lines intersecting the spirals give the shell an obscurely cancellate appearance under the microscope. Inner lip has a heavy granulated callus. Outer lip thickened and irregularly denticulated.

Dimensions of holotype—Height 16.5, diameter 12 mm.

This species differs from *M. oniscus* Linnaeus in having six axial ribs while *oniscus* has only three. The spire of *floridana* is higher than that of *oniscus*.

Age.—Pliocene.

Locality.—Prairie Creek, Fla.

Cymia caloosana Tucker and Wilson, n. sp. Pl. 2, fig. 8

Outline and general appearance as indicated by the figure.

This species differs from *C. henekeni* Maury in having much less strongly developed riblets on the early post-nuclear whorls. The very early whorls of *caloosana* have a spiral row of tubercles while in *henekeni* this character appears to develop later. The spirals of *caloosana* are crowded while those of *henekeni* are not. Shoulders somewhat more angulated in *caloosana* and the tendency to produce a double row of tubercles on the body whorl appears early in the development of the shell. It is apparently a persistent characteristic. This character appears on only one of the Santo Domingo shells.

Dimensions of holotype.—Height 36, diameter 24 mm.

Age.—Pliocene.

Locality.—Port Mayaca, Fla.

Peristernia insula Olsson Pl. 4, fig. 3

Peristernia insula Olsson, 1922, Bull. Am. Pal., vol. 9, p. 282, pl. 8, fig. 11.

Two of the Florida specimens from Acline apparently agree very closely with the holotype in sculpture while a third from the same locality has much stronger, heavier spirals. The secondary spirals characteristic of the of the type are absent. None of our specimens has more than six post-nuclear whorls.

Dimensions of figured specimen.—Height 18.5, diameter 9 mm.

Age.—Miocene (Gatun) - Pliocene?

Locality.—Water Cay, Costa Rica, Olsson. Acline, Fla.

Peristernia filicata Conrad Pl. 1, fig. 11

Buccinum (*Pollia*) *filicatum* Conrad, 1843, Proc. Acad. Nat. Sci., Phila., vol. 1, p. 308.

Lathyrus (*Peristernia*) *filicatus* Conrad, Cossman, 1901, Essais Pal. Comp., vol. 4, p. 47, pl. 2, fig. 16.

Peristernia filicata Conrad, Gardner and Aldrich, 1929, Proc. Acad. Nat. Sci. Phila., vol. 71, p. 18; Mansfield, 1930, Bull. Fla. Geol. Surv., 3, p. 64, pl. 17, fig. 4.

This species differs from *P. insula* in having less strong spiral sculpture, somewhat higher, more pointed spire and in having the nine ribs extend farther toward the base of the body whorl. This species is evidently quite rare in the Caloosahatchie.

Dimension of figured specimen.—Height 22, diameter 12 mm.

Age.—Miocene - Pliocene.

Locality.—Alum Bluff, Fla., Mansfield. Hosford, Fla., Mansfield. Near LaBelle, Fla.

Xancus wilsoni Conrad Pl. 1, fig. 10

Turbonella wilsoni Conrad, 1848, Jour. Acad. Nat. Sci. Phila., 2nd. ser. vol. 1, p. 120, pl. 12, fig. 12; Dall, 1890, Trans. Wag. Inst. Sci., vol. 3, p. 96.

Fusiform, spire elevated, acute, volutions ten, angular, nodose, the larger volutions somewhat concave above; the upper volutions with revolving lines obsolete or wanting on the lower ones; beak with coarse slightly raised revolving lines; aperture narrow, columella with three rather distant compressed plaits; the middle one largest; canal long. Length 5 inches.

The young of this series has distinct lines on every portion of the body whorl, where they are indistinct and remote.—Conrad.

Dimensions of figured specimen.—Height 40, diameter 18 mm.

Age.—Oligocene - Pliocene?

Locality.—Acline, Fla.

Marginella mansfieldi Tucker and Wilson, n. sp. Pl. 2, fig. 6

Shell high spired, solid, convex. A coat of enamel obscures the nuclear whorls. Five whorls, sutures impressed, shoulders sharp; somewhat excavated below the shoulder on the body whorl. Outer lip varical, inner margin denticulate. Columella has four prominent folds of which the anterior two are more oblique and the last forms the lower twisted edge of the columella.

Dimensions of holotype.—Height 12, diameter 6.5, length of aperture 7.25 mm.

This species appears to be related to *M. denticulata* Mansfield from which it differs in the greater sharpness of the shoulders, height of spire, thickening of the outer lip and stronger development of denticulations on the inner lip.

This species is named in honor of Dr. W. C. Mansfield of the United States Geological Survey.

Age.—Miocene ?

Locality.—Acline, Fla.

Mitra stephensoni aclinica Tucker and Wilson, n. subsp. Pl. 4, figs. 1, 4

Shell medium size, smooth nucleus of two or three whorls, well defined suture line. Five to seven post-nuclear whorls bearing strong sculpture of elevated, squared spirals. Interspaces about three times as wide. Three post-nuclear whorls each have three spiral, later whorls have four. Body whorl has eleven. One secondary spiral occurs in the interspaces of some of the large shells. Axial sculpture of flat, regularly spaced, narrow bands characteristic of *stephensoni* poorly developed or absent. Suture lines more distinct in this species.

Dimensions of holotype.—Height 19, diameter 7 mm.

Comparison with specimens loaned by Dr. Mansfield show that *stephensoni* (see pl. 4, fig. 2) is a much stouter shell than *aclinica.* The Acline specimens rarely have more than two columellar plaits while *stephensoni* commonly has four.

Age.—Miocene?

Locality.—Acline, Fla.

Mitra lineolata saginata Tucker and Wilson, n. subsp. Pl. 1, figs. 8, 9

Outline and sculpture as indicated by the figures.

Shell stouter than *M. lineolata* Heilprin. The sharp, raised spiral threads tend to become obsolete much sooner in the development of the shell than in typical *lineolata*. More deeply excavated below the suture. This subspecies is common at the type locality.

Dimensions of holotype.—Height 111, diameter 39 mm.

Age.—Miocene?

Locality.—Acline, Fla.

Conomitra sheldonæ, n. sp. Pl. 2, fig. 12

Shell small, nucleus of two smooth whorls. Following six whorls sculptured with strong, narrow, sharply elevated ribs. Three elevated lines at the shoulder which override the ribs. The line just below the shoulder angle is the strongest. Middle of the body whorl carries spiral sculpture of obsolete lines. Spirals stronger anteriorly and more closely spaced at the base. Four plications on the columella, which become stronger posteriorly.

Dimensions of holotype.—Height 18, 8.5 mm.

C. staminea Conrad has markedly more angulated shoulders, is much less slender and has stronger spirals than *sheldonæ*.

Age.—Miocene?

Locality.—Acline, Fla.

Oliva sayana var. immortua Pilsbry and Brown Pl. 2, fig. 11

Oliva sayana var. *immortua* Pilsbry and Brown, 1917, Proc. Phila. Acad. Nat. Sci., vol. 69, p. 33, pl. 5, fig. 6; Olsson, 1922, Bull. Am. Pal., vol. 9, p. 89, pl. 7, figs. 6. 7.

This shell differs from the recent *O. sayana* (*litterata*) by being smaller, less broad at the base, *the sutural channel broader and deeper,* and the ledge which encircles the shell above the siphonal fasciole is closer to the upper siphonal plait at the edge of the apertural callus. The outer lip is well thickened, indicating maturity.—Pilsbry and Brown.

Dimensions of figured specimen.—Height 28, diameter 11.5 mm.

Age.—Miocene (Gatun)

Locality.—Acline, Fla. Banana River, Costa Rica, Olsson, Cartagena, Columbia, Pilsbry and Brown.

Cymatosyrinx lunata aclinica Tucker and Wilson, n. subsp. pl. 4, figs. 6, 7

Form and sculpture as indicated by the figures.

This subspecies differs from *C. lunata* Lea (see pl. 4, fig. 5) in having a strongly developed, beaded spiral at the suture. The ribs of the body whorl tend to divide, in *aclinica,* near the base on the ventral surface and to decrease in number on the dorsal side by uniting near the base of the whorl.

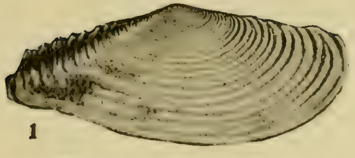
Dimensions of holotype.—Height 63, diameter 22 mm.

Age.—Miocene?

Locality.—Acline, Fla.

EXPLANATION OF PLATE 1 (10)

FIGURE		PAGE
1.	**Tellina interrupta** Wood Port Mayaca, Fla.	6
2.	**Cardita aclinica** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	5
3,4,5.	**Morum floridana** Tucker and Wilson, n. sp. Holotype. Prairie Creek, Fla.	9
6.	**Barbatia (Acar) aclinensis** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	3
7.	**Strombus mayacensis** Tucker and Wilson, n. sp. Young shell. Height 46.5, diam. 15.5mm. Port Mayaca, Fla.	8
8.	**Mitra lineolata saginata** Tucker and Wilson, n. sp. Young shell. Height 28, diam. 11mm. Acline, Fla.	12
9.	Same. Holotype. Acline. Fla.	
10.	**Xancus wilsoni** Conrad	10
11.	**Peristernia filicata** Conrad	10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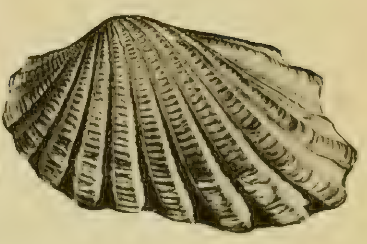
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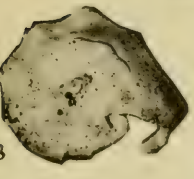
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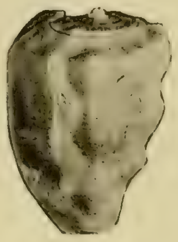
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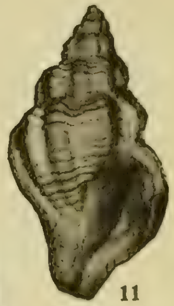
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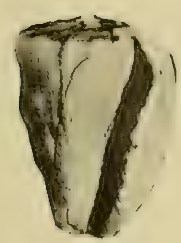
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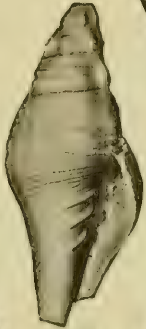
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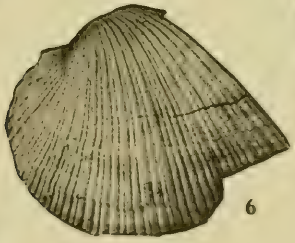
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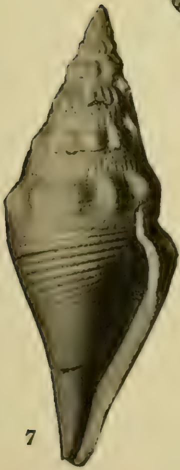
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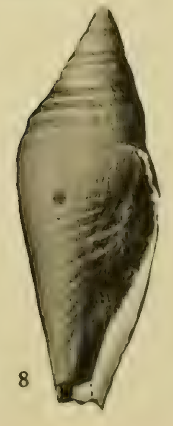
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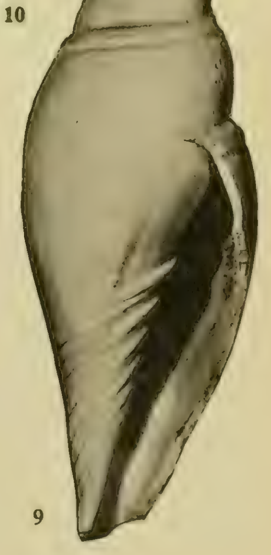
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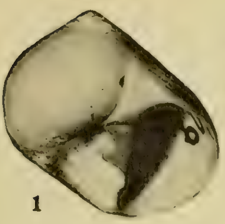
PLATE II

EXPLANATION OF PLATE 2 (11)

FIGURE		PAGE
1.	**Polinices floridana** Tucker and Wilson, n. sp. Holotype. Ft. Denaud, Fla.	7
2.	**Natica (Natica) castrenoides** Woodring Acline, Fla.	8
3,4.	**Pedalion (Casteria) kecia** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	3
5,9.	**Barbatia (Acar) aclinensis** Tucker and Wilson, n. sp. Young specimen. Height 7.5, width 13mm. Port Mayaca, Fla.	3
6.	**Marginella mansfield** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	11
7.	**Polinices subclausa** Sowerby Acline, Fla.	7
8	**Cymia caloosana** Tucker and Wilson, n. sp. Holotype. Port Mayaca, Fla.	9
10.	**Turbo wellsi** Tucker and Wilscn, n. sp. Holotype. Moore Haven, Fla.	7
11.	**Oliva sayana immortua** Pilsbry and Brown Acline, Fla.	12
12.	**Conomitra sheldonae** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	12
13.	**Pecten ernestsmithi** Tucker Holoytpe. Acme, N. C.	4
14.	**Colubraria aclinica** Tucker and Wilson, n. sp.	8



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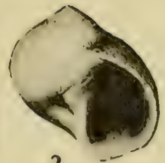

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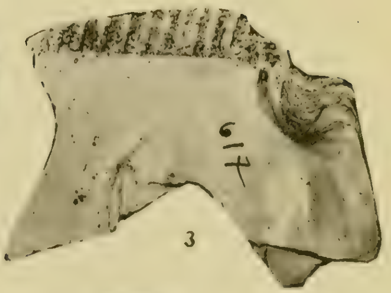

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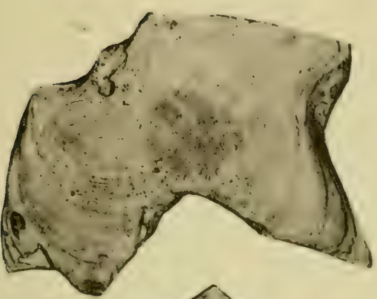

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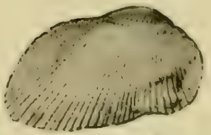

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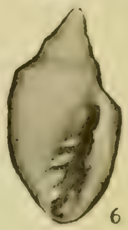

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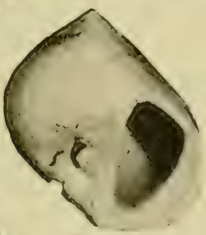

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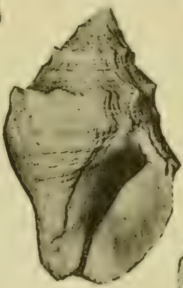

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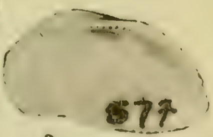

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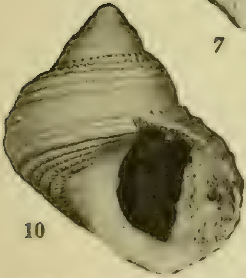

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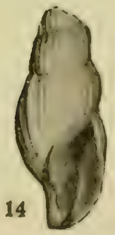

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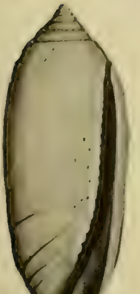

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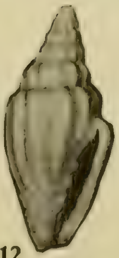

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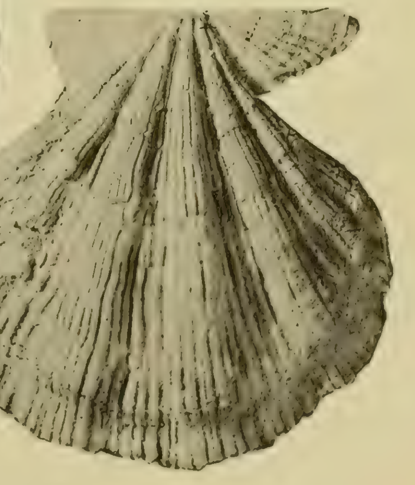

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PLATE III

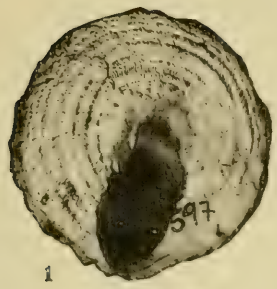
EXPLANATION OF PLATE 3 (12)

Figure Page

1. **Astralium americanum** Gmelin 6
Port Mayaca, Fla.

2. **Strombus inermis** Swainson 8
Height 152, diam. 113
West Indies (Newcomb Coll.).
Compare S. **mayacensis.**

3,5. **Strombus mayacensis** Tucker and Wilson, n. sp. 8
Holotype. Port Mayaca, Fla.



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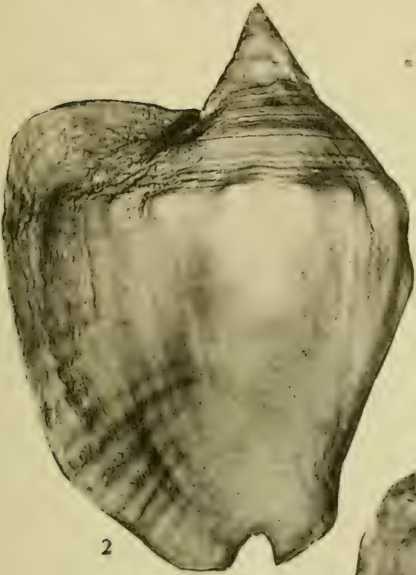

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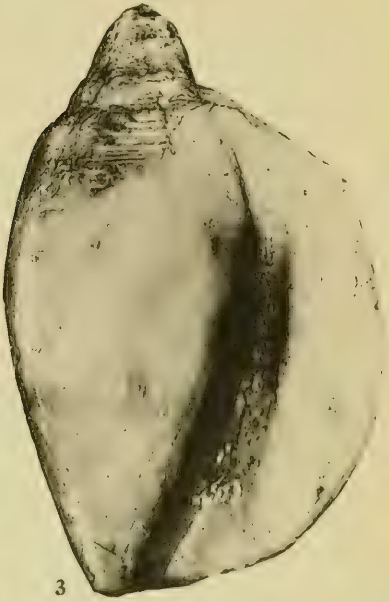

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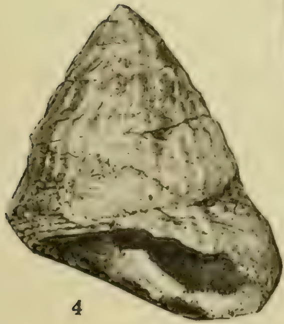

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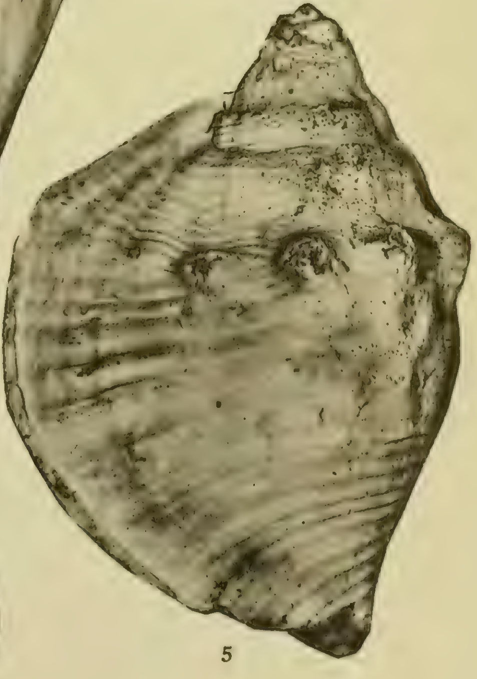

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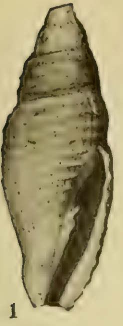
PLATE IV

EXPLANATION OF PLATE 4 (13)

Figure		Page
1.	**Mitra stephensoni aclinica** Tucker and Wilson, n. subsp. Acline, Fla. Holotype.	11
2.	**Mitra stephensoni** Mansfield U. S. National Museum no. 370068. Height 21, diam. 9mm. Liberty County, Fla.	11
3.	**Peristernia insula** Olsson Acline, Fla.	10
4.	**Mitra stephensoni aclinica** Tucker and Wilson, n. subsp. Young specimen. Acline, Fla.	11
5.	**Cymatosyrinx lunata** Lea Alum Bluff, Fla.	13
6,7.	**Cymatosyrinx lunata aclinica** Tucker and Wilson, n. subsp. Holotype. Acline, Fla.	13
8,9.	**Placunanomia aclinica** Tucker and Wilson, n. sp. Holotype. Acline, Fla.	5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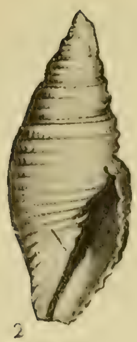
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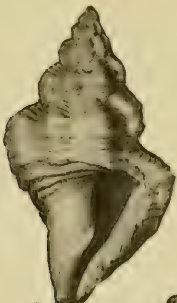
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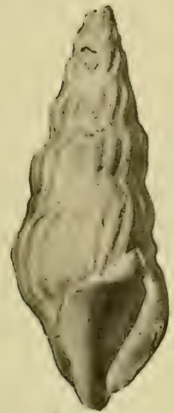
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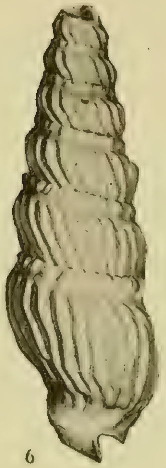
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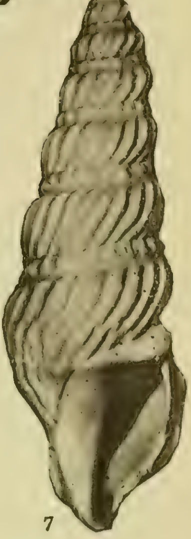
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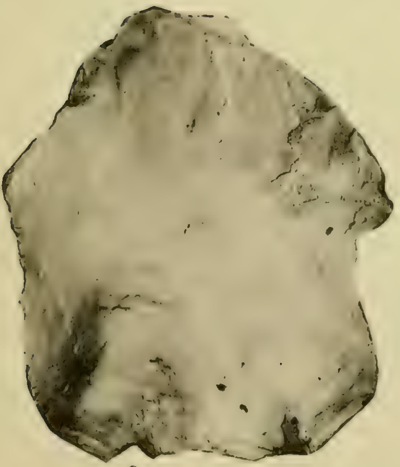
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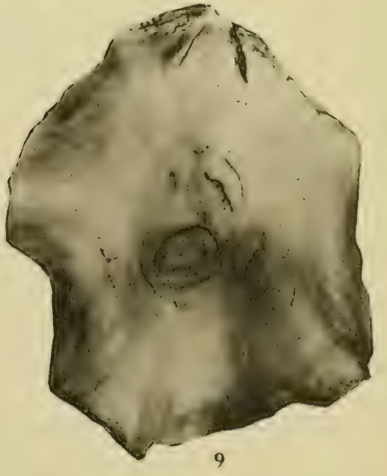
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BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 18

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No. 67

Corals of the Cretaceous of the Atlantic and Gulf Coastal Plains and Western Interior of the United States

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August 3, 1933

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INTRODUCTION

PREVIOUS WORK

Nearly a century ago Morton (1834)[1] published figures of two species, *Turbinolia inauris* and *Anthophyllum atlanticum* from the upper Cretaceous of New Jersey. Unfortunately it has since proved impossible to identify these two species and the names are no longer recognized. Later workers, Lonsdale (1845), Milne-Edwards and Haime (1857), and Bölsche (1870), discussed these species but added little to what was already known. Vaughan (1900) examined what were supposed to be Morton's types of the species in the Academy of Natural Sciences of Philadelphia, but could not identify them with the figures published by Morton.

The second reference, if we except Lonsdale's unsatisfactory discussion of Morton's species, is by Roemer (1849), who described *Astrocoenia guadalupae* from the lower Cretaceous of central Texas. Later, (1852), he published figures of this species which he had first made known only by a brief description.

Five years later Conrad (1857) described one species, *Turbinolia texana,* from the lower Cretaceous of western Texas. In the present paper the species is referred to the genus *Coelosmilia.*

The description of the Cretaceous corals has progressed in desultory fashion up to the present time, with some exceptions. The first of these is the description of five species of corals from the *Requienia* beds of the upper Edwards limestone of central Texas by Roemer, 1888). The second is a paper of some length by Felix (1891) on the Neocomian reef corals in the state of Puebla, Mexico. The third is a paper by Vaughan (1899) on the upper Cretaceous corals of Jamaica. Here may be mentioned Vaughan's brief paper on the corals of the Buda limestone of Texas (1903). More recent are three papers published within the last 17 years.

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[1] Dates in parenthesis in these introductory remarks refer to the papers listed in the chronological list of works.

Stephenson (1916) has described and figured well the American species of *Micrabacia.* Vaughan (1920) described a small fauna (6 species) from the Cannonball marine member of the Lance formation of South Dakota. The latest paper is by the present author (1932) on the corals of the Trinity Division of central Texas.

SCOPE OF THE PRESENT PAPER

In the past the Cretaceous corals of the United States have been described more or less sporadically with the result that knowledge of them is scattered through a score or more of different publications made at different dates between 1834 and 1932. The present paper is an attempt to present collectively the results of old and new investigations and to treat them as a whole. For information, type specimens have been examined and re-described where possible, the literature studied when the types were not available, and undescribed corals in various collections described and figured. More specifically, this paper contains references to, or descriptions of 146 species and varieties representing 68 genera, 22 families, and the 3 suborders of the order *Madreporaria.* Several new families or emendations of old families are proposed, 5 new genera are created, and in the case of each genus the genotype has been determined. In considering the stratigraphic distribution of the Cretaceous corals, it has been deemed pertinent to include all of North America, rather than be confined by the boundaries of the United States. This is because our American faunas in some instances are derived from southern faunas and in others are distinct from the southern assemblages, due to different but contemporaneous environmental conditions.

SOURCES OF MATERIAL

An effort has been made to examine as much material as possible. Most of the specimens described were contained in collections belonging to the following institutions:

1. United States National Museum, Washington, D. C.
2. Texas Christian University, Fort Worth, Texas.

3. Department of Geology, University of Texas, Austin, Texas.

4. Bureau of Economic Geology, University of Texas, Austin, Texas.

Other specimens were collected by the author and graduate students of the Department of Geology of the University of Texas. Although there are specimens in other institutions and collections, the author believes that he has examined most of the accessible material.

TYPE SPECIMENS

The exact place of deposition of the type specimens is mentioned in the description of the species. Most of these specimens are in the United States National Museum. The principal exceptions are the types of the species from the Travis Peak and the Glen Rose formations and the Buda limestone, which are retained by the Department of Geology of the University of Texas.

In the case of species not described as new in this paper or in my previous work on the Trinity Division, the location of the types is listed according to the authors of the species:

1. Bölsche, (1870) ?
2. Conrad, (1857) — United States National Museum.
3. Cragin, (1893) — ?
4. Cragin, (1895) — Colorado College, Colorado Springs, Colorado.
5. Hoffmeister, (1929) — United States National Museum.
6. Meek, (1876) — United States National Museum.
7. Morton, (1834) — Academy of Natural Sciences of Philadelphia.
8. Roemer, (1849) — University of Bonn, Bonn, Germany.
9. Roemer, (1888) — University of Breslau, Breslau, Germany.
10. Stephenson, (1916) — United States National Museum.
11. Vaughan, (1900) — Academy of Natural Sciences, Philadelphia.
12. Vaughan, (1903) — United States National Museum.
13. Vaughan, (1920) — United States National Museum.
14. Weller, (1907) — Academy of Natural Sciences, Phila-

delphia.

15. White, (1879) — United States National Museum.
16. White, (1884) — United States National Museum.

ACKNOWLEDGEMENTS

In the preparation of this paper the author has received much valuable assistance from many persons and several institutions and he here wishes to make grateful acknowledgement to:

Dr. T. Wayland Vaughan, Director of the Scripps Institution of Oceanography, for his invaluable critical advice.

Professor G. D. Harris of Cornell University, for his constant encouragement and material assistance.

Dr. F. L. Whitney of the University of Texas, for the loan of specimens from the Buda limestone and other formations.

W. S. Adkins of the Bureau of Economic Geology, of the University of Texas, for the loan of specimens from west Texas and information concerning their occurrence.

Dr. Gayle Scott of Texas Christian University, for the loan of many specimens from ceneral Texas.

Dr. R. H. Cuyler of the University of Texas, for specimens from, and information regarding the Travis Peak formation.

M. A. Stainbrook of Texas Technological College, Lubbock, Texas, for the loan of specimens from west Texas.

Dr. T. W. Stanton of the United States Geological Survey for the loan of valuable specimens from the lower Cretaceous.

Dr. J. B. Reeside, Jr., of the United States Geological Survey, for information regarding the occurrence of the corals in the Western Interior, and loan of specimens.

Dr. L. W. Stephenson of the United States Geological Survey, for many valuable details of the occurrence of corals in the Atlantic and Gulf Coastal Plains, and loan of specimens.

The authorities of the United States National Museum for the opportunity of working in that institution and for the loan of specimens.

The National Research Council, Division of Geology and Geography, for the opportunity given to the author of completing the main part of the work by the award of a Storrow Fellowship during the year 1931-1932.

STRATIGRAPHIC DISTRIBUTION OF CRETACEOUS CORALS IN NORTH AMERICA

LOWER CRETACEOUS

GENERAL CONSIDERATION

During certain epochs of the Cretaceous true coral reefs (bioherms) were developed as extensively as in the Jurassic and were of world-wide distribution. The climax of reef-building in the Jurassic came near the close in the Portlandian, whereas the reefs of the Cretaceous showed wide extension in the lower Cretaceous (Urgonian facies) and again in the upper Cretaceous (Senonian).

The Cretaceous reefs are nearly always associated with banks of caprinids or rudistids as in the lower Glen Rose formation in central Texas, earlier formations in Mexico, and elsewhere in the world. In the following paragraphs are discussed occurrences of corals in the lower Cretaceous (Comanchean) of North America.

AREAS OUTSIDE OF THE UNITED STATES

West Indies.—Although lower Cretaceous rocks may be present in the West Indian region, no corals are known from them. Gregory[2] has described one species, *Dendroseris harrisoni* Gregory, from the middle Cretaceous Bousignac limestone of Trinidad.

Mexico.—In Mexico, the lower Cretaceous formations are of greater age than those occurring in the United States. In south central Mexico there is apparently an unbroken sequence from the Jurassic into the lower Cretaceous, and it is in these formations, as well as the succeeding ones, that we must look for the forerunners of the coral faunas of the Comanchean of Texas. It appears that the limestones of San Antonio de las Salinas, Tehuacan, Puebla, contain the coral fauna which subsequently appeared in a modified form in central Texas as the lower Glen Rose reef-builders. These beds have been described by Burckhardt[3] and given by him an Hauterivian-Lower Barremian age. The coral fauna has been described by Felix[4], but his list needs considerable revision. I present a tentative list of these corals.

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[2] Gregory, J. W. Dendroseris, n. g. and other corals from Trinidad. **Geol. Mag.**, vol. 66, pp. 65-68, pl. 8, 1929.

Stylophora tehuacaneusis Felix 1891
Dendrogyra mariscali Felix 1891
Eugyra sp. aff, E. neocomiensis de Fromentel 1857
Eugyra sp. aff. E. cottaldina (d'Orbigny) 1850
Cyathophora atempa Felix 1891
Cyathophora micrommatos (Felix) 1891
Stylina ? sp. aff. S. neocomiensis (d'Orbigny) 1850
Latusastrea sp. aff. L. polygonalis (de Fromentel)
Latusastrea sp. aff. L. provincialis d'Orbigny
Stylangia anomalos Felix 1891
Astrocoenia sp. aff. A. globosa (de Fromentel) 1887
Calamophyllia sandbergeri Felix 1891
Cladophyllia miroi Felix 1891
Orbicella ? cyclops (Felix) 1891
Orbicella ? nannodes (Felix) 1891
Dimorphophyllia wollheimi (Felix) 1891
Thamnosteria xipei Felix 1891
Thamnasteria ? sp. cf. T. stricta de Fromentel 1857
Thamnasteria crespoi Felix 1891
Dimorphastrea ? petalophyes Felix 1891
Thamnoseris ? arborescens Felix 1891
Polyphyllastrea ? tenochi Felix 1891
Siderofungia zitteli Felix 1891
Siderofungia irregularis Felix 1891
Meandrarea tulae (Felix) 1891
Meandrarea ? montezumae (Felix) 1891
Meandrarea ? sauteri (Felix) 1891
Meandrarea steini (Felix) 1891
Mastophyllia conophora Felix 1891
Meandrarea ? sp. (Felix) 1891
Polyphyllastrea polymorpha (Felix) 1891
Dimorpharaea barcenai (Felix) 1891
Thamnaraea holmoides Felix 1891

A coral fauna which may be even more closely related to the Trinity faunas has been noted by Burckhardt[5] in the Lower Aptian in the region of Rio Nazas, Durango, where there are caprinid and *Nerinea* reefs below the zone of *Dufrenoya texana* (Trinity). This represents the Urgonian faces. Unfortunately, this fauna remains undescribed.

In the marls and shales of the Albian, corals are found associated with *Exogyra texana* and *Schloenbachia acutocarinatum* in

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[3] Burckhardt, C. Etude synthétique sur le Mésozoique mexicain. **Mém. Soc. Pal. Suisse**, vol. 50, p. 159, 1930.

[4] Felix, J. Versteinerungen aus der mexikanischen Jura-und Kreide-formation. **Paleontographica**, vol. 37, pt. 6, pp. 140-194, pls. 22-30, 1891.

[5] Burckhardt, C. op. cit., p. 140, 1930.

EUROPEAN TIME EQUIVALENTS	KANSAS	NORTH TEXAS	CENTRAL TEXAS	PECOS CO.	CULBERSON-HUDSPETH CO.
CENOMANIAN	?	*Absent*	Buda Limestone	*Absent*	Buda Limestone
		Grayson	Del Rio		Del Rio
		Main Street		Upper Cap Rock	Upper Georgetown
UPPER ALBIAN		Pawpaw	Georgetown Formation	?	Georgetown Formation
		Weno		Weno	
		Denton		Middle Cap Rock	
		Ft. Worth		Ft. Worth	
		Duck Creek		Duck Creek	
MIDDLE ALBIAN	Kiowa Champion Shell Bed ?	Kiamichi	Edwards	Kiamichi	Unnamed
		Goodland	Comanche Peak	Fredericksburg Clay Comanche Peak	
		Walnut	Walnut	Walnut ?	
LOWER ALBIAN ?	Cheyenne ? Sandstone	Paluxy	Glen Rose	*Absent*	Finlay
APTIAN		Glen Rose			Cox
		Basal Sand	Travis Peak		Etholen
PORTLANDIAN ?	*Absent*	*Absent*	*Absent*	*Absent*	Malone

FIG. 1 CORRELATION OF THE LOWER CRETACEOUS DEPOSITS OF SOUTHWESTERN UNITED STATES.

northern Mexico[6] in the vicinity of San Pedro del Gallo, Durango. The Edwards limestone fauna of Texas may be related to that of the rudistid banks[7] in the region of San Pedro del Gallo, in Michoacan and Orizaba, of Albian age.

Aguilera[8], listing the corals from the Mexican Cretaceous, mentions two species, *Thamnastroea* (sic) *pedunculata* de Fromentel and *Trochoseris sinuosa* de Fromentel, which are described by Urquiza[9] from beds of Cenomanian ? age in the district of Coalcoman, Estado de Michoacan. In a footnote he adds that these species are probably incorrectly identified and doubts even the generic identification.

The lower Cretaceous Mexican coral faunas, with the exception of that described by Felix, are relatively unknown and no close parallels with the Texas faunas can be drawn until they are described.

Canada.—Only two species of corals have been described from the Mesocretaceous rocks of Canada. These are *Smilotrochus vancouverensis* Whiteaves[10] and *Astrocoenia irregularis* Whiteaves[11]. The first species occurs in the Vancouver group of Hornby Island, the second in the same group on Maude Island, British Columbia. This group is Cenomanian (?) in age.

AREAS WITHIN THE UNITED STATES

The correlation table, mainly after Adkins[12], in Fig. 1, shows the relationships of the lower Cretaceous formations in the southwestern United States in which corals are found, together with the European time equivalents.

[6] Aguilera, J. G. Apercu sur la géologie du Mexique pour servir d'explication a la carte géologique de l'Amérique du nord. **Int. G. Cong.** X, Mexico C. R. pp. 227, 248, 1907.

[7] Burckhardt, C. op. cit., vol. 50, p. 174, 1930.

[8] Aguilera, J. G. Synopsis de geologia mexicana. **Mex. I. G., Bol.** 4-6, pp. 187-250, 1897.

[9] Urquiza, M. Exploracion de Coalcoman, Estado de Michoacan, Mexico. Mexico, **Min. de Fom.,** An. 7, pp. 195-261, map, il., 1882.

[10] Whiteaves, J. F. On the fossils of the Cretaceous rocks of Vancouver and adjacent islands in the Strait of Georgia. **Canada Geol. Survey,** Mes. Foss., vol. 1, pt. 2, p. 178, pl. 20, figs. 7-7a, 1879.

[11] Whiteaves, J. F. On some additional or imperfectly understood fossils from the Cretaceous rocks of the Queen Charlotte Islands, with a revised list of the species from those rocks. **Canada Geol. Survey,** Mes. Foss., pt. 3, p. 246, 1884; pt. 4, pl. 33, fig. 1, 1900.

[12] Adkins, W. S. Handbook of Cretaceous fossils. **Univ. of Texas, Bull.** 2838, p. 7, 1928.

Trinity Division.—The Trinity division contains the lowest Cretaceous rocks in Texas, in ascending order, the Travis Peak formation, and Paluxy sand. The rocks range in age from Aptian through lower Albian.

Travis Peak Formation.—This formation, the lowest of the Trinity division, was deposited in a warm, shallow sea, transgressing from the south, bringing with it modified invertebrate faunas from Mexico. Only two species of corals are known at present from this formation: *Orbicella travisensis* Wells 1932, and *Siderastrea cuyleri* Wells 1932. Both species are found in the Cow Creek beds in Travis and Burnet Counties. These beds contain several large banks of oysters near which the corals are found. True coral reefs did not develop and the corals were small heads which grew near shore upon submerged banks swept by currents, and were afterwards subjected to much wear on the sandy bottom.

Although the Travis Peak species are found stratigraphically but a short distance below the Glen Rose, they are not closely related to the true reef fauna which invaded more southerly areas at the beginning of the deposition of the Glen Rose formation.

Glen Rose Formation.—The coral fauna of this formation has already been the subject of a paper by the author[13], and in the present work these corals are not discussed, unless some new information has been adduced.

This fauna is distributed through the Glen Rose as indicated in the following list:

1. Basal Glen Rose.
2. Lower Glen Rose.
3. *A. roemeri* beds.
4. Upper Glen Rose.

SPECIES	1	2	3	4
Tiarasmilia casteri Wells 1932		x		
Parasmilia bullardi Wells 1932		?		
Pleurosmilia sp. Wells 1932		x		
Cyathophora haysensis Wells 1932		x		
Connectastrea infundibuliformis Wells 1932				x
Stephanocoenia ? guadalupae Wells 1932	x			
Astrocoenia whitneyi Wells 1932	x	x		
Astrocoenia scyphoidea Wells 1932		x		
Aplosmilia ? tolmachoffana Wells 1932		x	x	
Eugyra cuyleri Wells 1932		x		

---

[13] Wells, J. W. Corals of the Trinity group of the Comanchean of central Texas. **Jour. Paleont.**, vol. 6, no. 3, pp. 225-256, pls. 30-39, 1932.

Orbicella whitneyi Wells 1932	x	x	
Orbicella ? comalensis Wells 1932		?	
Thecosmilia ? sp. Wells 1932		x	
Blothrocyathus harrisi Wells 1932		x	
Hydnophora ? blanchoensis Wells 1932		x	
Isastrea ? whitneyi Wells 1932	x	x	
Complexastrea ? glenrosensis Wells 1932		x	
Centrastrea vaughani Wells 1932	x	x	
Cyathomorpha ? damoni Wells 1932		x	
Diploastrea harrisi Wells 1932		x	
Siderofungia irregularis Felix 1891	x	x	
Polyphyllastrea simondsi Wells 1932		x	
Meandrarea plummeri Wells 1932		x	
Meandrarea sp. cf. M. tulae (Felix) 1891		x	
Dimorpharaea sp. cf. D. barcenai (Felix) 1891		x	
Microsolena texana Wells 1932		x	x
Heterocoenia hilli Wells 1932			x
Astreopora ? leightoni Wells 1932			x
Epiphaxium labyrinthicum Wells 1932		x	
Comalia fasciculata Wells 1932		x	
Polytremacis ? hancockensis Wells 1932			x

In the introduction to the paper cited above, I have said, regarding the distribution of the corals:

> The first reef appears in the heavy limestones at the base of the Glen Rose formation in the western part of Comal County. Here massive heads of *Isastrea whitneyi, Orbicella whitneyi, Astrocoenia whitneyi,* etc., are scattered about in great profusion, most of them badly weathered, although they are well enough preserved when found in place. This basal reef appears to have established itself upon a foundation consisting of large masses or layers of caprinids and attained a height of 3 to 10 feet over an area of several square miles. The number of species is not as great as in the reefs at higher horizons—6 in the basal reef, as compared with a total of 24 in the higher reefs along Blanco River.
>
> The other reefs are similar to the basal ones in that they are built upon a foundation of caprinids, which continued to flourish as the corals grew upward. They are, however, much thicker and present a more diversified fauna. The two principal exposures of the reefs of the middle lower Glen Rose are at the Narrows of Blanco River, about 11 miles east of Blanco City, Blanco County, and in a cliff on Blanco River about one mile west of Pleasant Valley Crossing, Hays County. The reef exposed at the latter locality also outcrops nearer Pleasant Vallee Crossing, near the house of Kreh's ranch where it presents a different facies from the exposures farther upstream. These reefs attain a thickness of approximately 30 feet at the Blanco Narrows, and 15 feet in the vicinity of Pleasant Valley Crossing. They are stratigraphically about 100 feet above the basal reefs, but the equivalency of the two exposures is uncertain. Several of the same species occur at both reefs but they represent different facies. At the Blanco Narrows the colonies are principally massive rounded clumps of the type well suited to the rough water near the margins of a reef, and which are much the same as those of the basal reefs whereas the reef exposed about a mile above Pleasant Valley Crossing presents corals of facies more suited to the quieter waters found within the reef margins—thin plate-like expansions of *Meandraraea* and *Polyphyllastrea,* tall cylindrical *Blothrocyathus* and *Siderofungia,* open clumps of *Aplosmilia* and slender branches of *Centrastrea,* although massive heads of *Astrocoenia* and *Microsolena* and thick masses of *Eugyra* are also abundant. The associated

fauna of delicate brachiopods and thin-shelled *Alectryonia* at this latter reef also indicates quieter waters. The exposure of this reef near Kreh's ranch house, however, contains many of the same species but of a facies similar to that found at the Blanco Narrows.

The third horizon is in the clayey limestone of the *Arctica roemeri* beds about 200 feet above the base of the Glen Rose. Several species occur here which have not been found at the lower horizons, although some of the species have been noted. All of the specimens are poorly preserved as molds of the exterior and their determination is very difficult.

Neither of the two species found in the Travis Peak formation has been found to occur in the Glen Rose.

Regarding the geologic age and relations with other coral faunas, I have said nothing in my previous paper; therefore it is pertinent to discuss them here in some detail.

Age of the Glen Rose Formation.—Although this formation lies near the base of the Cretaceous system as it is developed in Texas, it is younger than formations occuring farther south in Mexico which are given a Neocomian age. The general consensus of opinion is that the Trinity Division, which includes the Glen Rose, is of Aptian age. As such it is considered by Scott[14] and Adkins[15], who place the lower Glen Rose near the Gargasian horizon. It is sustained by Böse and Cavins[16]. Burckhardt[17] considers it to represent the Clansayes horizon. The upper part of the Glen Rose may be lower Albian. These considerations of the age are based in the main upon the ammonites and rudistids, and the results are, with some modification, as will be presently shown, borne out by the coral fauna.

THE URGONIAN REEF-FACIES IN HAYS, COMAL, AND BLANCO COUNTIES

The reef-coral fauna of the lower Glen Rose associated with rudistids and caprinids in veritable reefs or bioherms is undoubtedly the northern and post-contemporaneous extension of the similar bioherms of the Aptian of Mexico which I have discussed on the preceding pages. Unfortunately, corals are simply noted as occurring in the Urgonian facies in that country, and no attempts have yet been made to describe them. It is likely that they are related to the Hauterivian-Lower Barremian fauna described by Felix. I have, in this latter connection, identified one of the Glen Rose corals with one from these lower Zapotitlan beds, *Siderofungia irregularis* Felix, and placed two others in affinity, *Meandrarea* sp. cf. *M. tulae* (Felix) and *Dimorpharaea* sp. cf. *D. barcenai* (Felix). I venture to suggest that the investigation of the Mexican Aptian coral faunas will reveal forms intermediate between those of the Zapotitlan and the Glen Rose.

---

[14] Scott, Gayle. Etudes stratigraphiques et paléontogiques sur les terrains crétacés du Texas. Grenoble, p. 40, 1926.

[15] Adkins. W. S. Handbook of Texas Cretaceous Fossils. **Univ. of Texas, Bull.** 2838, p. 9, 1928.

[16] Böse, E. and Cavins, O. A. The Cretaceous and Tertiary of southern Texas and northern Mexico. **Univ. of Texas, Bull. 2748, 1927.**

There is little doubt that the lower Glen Rose formation as it is developed in Hays, Comal, and Blanco Counties represents that facies of the Aptian referred to as the Urgonian. The Urgonian, originally designated by d'Orbigny as an horizon of the upper Barremian, is now understood to include that facies of the upper Barremian and the Aptian represented by massive zoogenic limestones, bearing a characteristic rudistid fauna and rarely ammonites, which occurs in several parts of the world, and which is distinct from the littoral and bathyal facies. It may be considered as a special phase of the neritic facies characterized by warm, clear water fairly remote from land, typical reefs of corals or rudistids. Such an interpretation implies no definite horizon for the Urgonian in the upper Barremian or Aptian and it may occur at one or more horizons in any area within these stages. Thus, in the Rio Nazas (Durango), Saltillo, and Sierra de Oballos districts in Mexico, the Urgonian facies appears in the lower Aptian beneath the Gargasian horizon, and in Texas it appears in the upper Aptian. The succession of beds in Hays, Comal, and Blanco Counties may be generalized as follows:

1. Alternating marls and limestones (upper Glen Rose=lower Albian ?)
2. Heavy limestones, with rudistids, corals, zones of Nerineas, etct. (lower Glen Rose=Aptian=Urgonian)
3. Sandstones ⎫
4. Limestones, Cow Creek Beds ⎬ Travis Peak=Aptian
5. Sandstones ⎭

URGONIAN REEF-CORAL FAUNAS

Under this heading I include a brief review of the principal described coral faunas of the Urgonian facies of the world. The lists of corals are interesting for comparison with the Glen Rose assemblage. In some cases I have rectified the nomenclature and added further data on some of the species.

France.—As has been pointed out by Dietrich[18], the coral fauna of the Urgonian facies in southeastern France is not well known. It is divided into a series of small local faunas, but their biologic character, whether reef-building or not, is not described in the literature. According to Kilian[19], the marls and limestones of Rimit (Isère), Barcelonne (Drôme), le Grand Veymont (Isère), and the environs of Sault (Vaucluse) are rich in corals. Only those in the latter locality were described by de Fromentel. The following is a list given by Kilian, with some corrections:

Trochocyathus subconulus Pillet
Stylohelia laevis de Fromentel
Astrocoenia urgonensis Koby
Astrocoenia sp.
Eugyra pusilla Koby
Eugyra interrupta de Fromentel
Stylina grasi de Fromentel
Stylina regularis de Fromentel
Stylina ? micropora Koby
Diplocoenia saltensis de Fromentel
Cryptocoenia picteti Koby
Cyathophora regularis de Fromentel
Calamophyllia corymbosa Koby
Calamophyllia compressa de Fromentel?
Montlivaltia ficus Math. (nom. Man.)
Isastrea dupasquieri Koby
Septastrea ? crassa de Fromentel
Favia ? conferta de Fromentel
Favia ? hemispherica de Fromentel
Hydrrophora crassa de Fromentel
Oroseris explanata de Fromentel
Meandraraea granulata (de Fromentel)
Stylomaeandra regularis de Fromentel
Dimorphastrea crassisepta d'Orbigny 1850
Dimorphastrea ? regularis de Fromental
Thamnasteria ? leunisi Roemer
Centrastrea index de Fromentel

Another fauna has been described by Boky[20] from the Jura mountains. It contains 48 species as follows:

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[18] Dietrich, W. O. Steinkorallen des Malms und der Unterkreide im Südlichen Deutsch-ostafrika. **Paleontographica**, suppl. 7, reihe 2, teil 1, lieferung 2, p. 57, 1926.

[19] Kilian, W. Contr. à l'Etude des Faunes Paléocrétacés du S. E. de la France. I. la Faune de l'Aptien inférieur des Environs de Montélimar (Drome). **Mém. Carte Géol. France.** p. 148, 1915.

[20] Koby; F. Monographie des Polypiers crétacés de la Suisse, 1896-1898.

Stylohelia jaccardi Koby 1896
Astrocoenia subornata (d'Orbigny) 1850
Astrocenia urgonensis Koby 1896
Astrocoenia pseudominima Koby 1896
Astrocoenia excavata de Fromentel 1857
Astrocoenia minima de Fromentel 1857
Astrocoenia triboleti Koby 1896
Astrocoenia jaccardi Koby 1897
Placosmilia urgonensis Koby 1895
Eugyra neocomiensis de Fromentel 1857
Eugyra cottaldina (d'Orbigny) 1850
Eugyra digitata Koby 1895
Eugyra pusilla Koby 1895
Stylina (Heliocoenia) picteti Koby 1895
Stylina paucistylina Koby 1895
Stylina favrei Koby 1895
Convexastrea desori Koby 1896
Convexastrea dubia Koby 1896
Cryptocoenia picteti Koby 1896
Orbicella ? picteti (Koby) 1896
Holocoenia jaccardi Koby 1896
Calamophyllia compressa d'Orbigny 1850
Calamophyllia stutzi Koby 1896
Calamophyllia ? corymbosa Koby
Hydnophora crassa de Fromentel 1862
Hydnophora picteti Koby 1896
Latomeandra kaufmanni Koby 1896
Latomeandra lorioli Koby 1896
Latomeandra picteti Koby 1896
Favia ? schmidti Koby 1896
Favia ? subturbinata de Fromentel 1857
Favia lorioli Koby 1896
Isastrea dupasquieri Koby 1896
Isastrea geometrica Koby 1896
Dimorphastrea crassisepta d'Orbigny 1850
Dimorphastrea bellula d'Orbigny 1850
Thamnasteria duparci Koby 1897
Thamnasteria golliezi Koby 1897
Thamnasteria schmidti Koby 1897
Thamnasteria dupasquieri Koby 1897
Thamnasteria maeandra (d'Orbigny) 1850
Thamnasteria favrei Koby 1897
Thamnasteria urgonensis Koby 1897
Microsolena guttata Koby 1897
Polyphyllastrea convexa d'Orbigny 1847
Meandraraea maeandroides Koby 1897
Thamnarea cancellata Koby 1897

In this paper he notes (p. 95), that probablby most of the species described from the Neocomian by de Fromentel are Urgonian.

Italy.—True coral reef limestones of Urgonian facies are found on the island of Capri, near Venassino, and the corals have been described by de Angelis d'Ossat.[21] The species included in the fauna are:

Platycyathus sp.
Pleurosmilia distefanoi de Angelis
Pleurosmilia neocomiensis de Fromentel 1861
Enallhelia rathieri d'Orbigny 1850
Cryptocoenia picteti Koby 1896
Cyathophora delorenzoi de Angelis
Eugyra pusilla pauciseptata de Angelis
Eugyra digitata Koby 1895
Eugyra cottaldina (d'Orbigny) 1850
Eugyra interrupta de Fromentel 1862
Dendrogyra kobyi de Angelis
Stylina (Acanthocoenia) cerioi de Angelis
Stylina sp.
Stylina steinmanni de Angelis
Stylina paronai de Angelis
Hydnophora oppenheimi de Angelis
Hydnophora picteti Koby 1896
Hydnophora crassa de Fromentel
Thecosmilia (Rhabdophyllia?) spp. 3
Aulastraea bassanii de Angelis
Amphiastrea gracillis caespitosa de Angelis
Amphiastrea waltheri de Angelis
Dimorphastrea lorioli Koby 1897
Thamnasteria sp. cf. T. favrei Koby 1897
Heterocoenia verrucosa Reuss 1850

Spain.—The Urgonian facies is well-developed in the provinces of Barcelona and the corals have been the subject of a paper by de Angelis d'Ossat.[22] The fauna is fairly large and the development of the *Trochosmiliae*[23] is astonishing:

*Peplosmilia sp.
Peplosmilia fromenteli de Angelis
Peplosmilia casanasi de Angelis
Peplosmilia iberica de Angelis
Peplosmilia catalaunica de Angelis
Peplosmilia coquandi de Angelis
Peplosmilia thildae de Angelis
Axosmilia almerai de Angelis
Axosmilia bofilli de Angelis
Pleurosmilia sp. cf. P. neocomiensis de From. 1861
Pleurosmilia stutzi Koby 1895
Pleurosmilia vaughani de Angelis
Pleurosmilia volzi de Angelis

*The reference to *Peplosmilia,* which is a Montlivaliid, is probably incorrect.

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[21] de Angelis d'Ossat, G. I coralli del calcare di Venassino (Isola di Capri). **Atti della R. Acc. d. Sci. fis. e mat.,** (2), vol. 12, 45 pages, 2 plates, 1905.

[22] de Angelis d'Ossat, G. Coralli del cretacico inferiore della Catalogna. **Paleontographica Italica** vol. 11, pp. 170-251, pls. 14-17, 1905.

[23] I am not certain that all of the species of the group mentioned are distinct.

Pleurosmilia kobyi de Angelis
Placosmilia sp. cf. P. arcuata E. & H. 1849
Epismilia ogilviei de Angelis
Epismilia frechi de Angelis
Epismilia irregularis Koby 1880
Epismilia robusta Koby 1895
Trochosmilia uricornis (Michelin) 1846
Trochosmilia sp. cf. T. obliqua (d'Orbigny) 1850
Trochosmilia portisi de Angelis
Trochosmilia nevianii de Angelis
Trochosmilia sandalina de Angelis
Trochosmilia spp. 3
Eugyra cottaldina (d'Orbigny) 1850
Aplosmilia vidali de Angelis
Convexastrea almerai de Angelis
Cryptocoenia picteti Koby 1896
Orbicella sp.
Orbicella exsculpta (Reuss) 1854 ?
Orbicella corollaris (Reuss) 1854 ?
Coeloria oceani (d'Orbigny) 1850
Iastrea sp.
Cladocora gabriellinae de Angelis
Brachyphyllia haueri Felix 1903
Theocosmilia catalaunica de Angelis
Montlivaltia humilis (d'Orbigny) 1850
Montlivaltia rudis (Sowerby) 1830
Montlivatia sp. cf. M. pateriformis (Michelin) 1847
Montlivaltia sp. cf. M. rugulosa Koby 1897
Montlivaltia sp. cf. M. kaufmanni Koby 1898
Leptophyllia eturbensis de Fromentel 1857
Thamnasteria stricta de Fromentel 1857
Dimorphastrea crassisepta subcrassisepta de Ang.
**Meandrarea submorchella (de Angelis)
**Meandraraea felixi (de Angelis)

East Africa.—Near the coast of Tanganyika Territory, (German East Africa), and Kenya Colony are limestones with the Urgonian reef facies, deposited in a transgressing sea, as in Texas. The two most important papers dealing with the corals are by Dietrich[24] and Gregory.[25] In regard to the Urgonian reefs, Dietrich notes that although corals are found in the underlying "*Smeei* beds" and "*Schwarzi* beds," and represent the first attempt in the building of coast line reefs on the African Gondwana continent, true reefs did not appear until Aptian time. He

**Described as *Latimaeandraraea* by de Angelis.

[24] Dietrich, W. O. Steinkorallen des Malms und der Unterkreide im südlichen Deutsch-ostafrica. **Paleontographica**, suppl. 7, reihe 2, teil 1, lief. 2, pp. 44-101, pls. 5-14, 1925.

[25] Gregory, J. W. The fossil corals of Kenya Colony collected by Miss McKinnon Wood. **Mon Geol. Dept. Hunterian Mus.**, Glasgow Univ. IV, pp. 200-202, pl. 18, 1930.

makes the interesting comment that all quiet water forms are absent, both of corals and other organisms. In Texas are found both quiet and rough water forms, but not at the same locality. The relations of the Urgonian facies with the geologic section are given by Dietrich,[26] after Hennig:

1. Kiturika mountains, near Narumbanga:
    Weathered limestone
    Compact limestone
    Coral bank
    Trigonia schwarzi bed
2. Nambawala hill:
    Minor coral bed
    Actaeonella-Nerinella bed
    Sondstone with coral fragments
    T. schwarzi bed

The specimens described by Gregory came from a limestone near Freretown, near Mombassa, Kenya Colony, and represent a northern extension of the fauna described by Dietrich. The following is a list of the species described by the two authors:

Trochosmilia ? sp.
Astrocoenia decaphylla (Michelin)
*Astrocoenia pseudominima Koby
Astrocoenia sp. cf. A. globosa (de Fromentel)
Astrocoenia asteriscus Weissermel
Amphiastrea aethiopica Dietrich
Aulastraea pompeckji Dietrich
††*Eugyra cottaldina pauciseptata Gregory
Eugyra digitata (d'Orbigny)
Placocoenia udlakashensis Dietrich
Placocoenia pluricostata Dietrich
Cyathophora sp.
Montlivaltia sp. az. M. pateriformis E. & H.
Orbicella sp. aff. O. neocomiensis (de Fromentel)
** *Orbicella polluciformis (Gregory)=** *O. sp. aff. O. simonyi (Reuss) (Dietrich)
Agathelia urgonica Dietrich
Septastrea ? recki Dietrich
Isastrea urgonica Dietrich
Isastrea sp. cf. I geometrica Koby
*Thomnasteria freriana Gregory=T. sp. cf. T. favrei Koby, Dietrich
†Meandraraea sp.
Campodocis brancai Dietrich
Camptodocis robusta (Weissermel)

*Species described by Gregory.
**Described as *Phyllocoenia* by Gregory.
***Described as *Heliastrea* by Dietrich.
†Described as *Latimaeandraraea* by Dietrich.
††Described as *E. cotteaui* by Dietrich.

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[26] Dietrich, W. O. op. cit., p. 55.

Japan.—The presence of the Urgonian reef-facies in the "*Orbitolina-rocks*" in the middle part of Hokkaidô and in the northern part of the Kitakami Mountainland has been recently noted by Yabe[27] who lists the following genera:

Pleurosmilia
Amphiastrea
Diplogyra (n. gen, nom. nud.)
Eugyra
Astrocoenia
Orbicella
Theocosmilia
Latiphyllia
Hydnophora
Thamnasteria
Heterocoenia

Venezuela.—Gregory[28] has described a reef-coral fauna which may represent the Urgonian facies, from two localities in eastern Venezuela. The species from Port Piritu are:

Thecosmilia sp. cf. T. tobleri Koby 1897
Stylosmilia alpina Koby 1897 ?
Diplarea venezuelensis Gregory 1927
Metethmos ? sp.
Thamnarea or Dimorpharaea

The species from Punceres are:

Diplocoenia occidentalis Gregory 1927
Thamnasteria harrisoni Gregory 1927

The second species listed from Punceres looks more like an *Astrocoenia* related to the *A. whitneyi* of Texas.

FREDERICKSBURG DIVISION

In all, 31 species are known from this division. These together with 1 from the upper Glen Rose, (lower Albian), and 10 from the Washita Division, (upper Albian), total 42 species representative of both reef-building and neritic types. This collective Albian fauna of the southwestern United States assumes considerable importance when compared with the relatively meagre coral faunas known from the Albian elsewhere in the world. Coral faunas which are probably related to those of the Fredericksburg are present in the rudistid beds of the Albian in the region of San Pedro dell Gallo, Durango, Mexico.[29] Of the Albian coral faunas elsewhere, that of the Gault at Haldon, England, in the zone of *Ammonites rostratus,* is perhaps the largest now known. According to Jukes-Browne,[30] the following species have been described:

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[27] Yabe, H. Colonial corals in the geological formations of the Japanese Islands. Proc. Imp. Acad., Japan, vol. 8, no. 7, p. 305, 1932.

[28] Gregory, J. W. Some lower Cretaceous corals from eastern Venezuela. Geol. Mag. 64, pp. 440-444, pl. 13, 1927.

Trochosmilia varians Duncan
Placosmilia cuneformis E. & H.
Placosmilia depressa E. & H.
Placosmilia magnifica Duncan
Placosmilia parkinsoni E. & H.
Placosmilia tuberosa E. & H.
Barysmilia cordieri E. &. H.
Barysmilia tuberosa Reuss
Baryhelia reticulata Duncan
Astrocoenia decaphylla E. & H.
Stelloria incrustans Duncan
Cyathophora monticularis d'Orbigny
Favia minutissma Duncan
Favia stricta E. & H.
Haldonia vicaryi Duncan
Peplosmilia austeni E. & H.
Isastrea haldonensis Duncan
Thamnasteria belgica E. & H.
Thamnasteria ramsayi Duncan
Trochoseris constricta Duncan
Trochoseris morrisii Duncan
Actinacis insignis Duncan
Actinacis stellulata Duncan

Another fauna, distinct from the above, is found in the lower Gault clays of Folkestone:

Caryophyllia bowerbanki E. & H.
Ceratotrochus insignis Duncan
Trochocyathus angulatus Duncan
Trochocyathus calcaratus Tomes
Trochocyathus conulus (Phillips)
Trochocyathus harveyanus E. & H.
Trochocyathus ? koenigi (Mantell)
Cyclocyathus fittoni E. & H.
Trochosmilia sulcata E. & H.
Isastrea sp.
Parasmilia sp.

These faunas represent two distinct facies. The first with its colonial forms of the hermatypic type is comparable to that of the Comanche Peak formation, and the second with its neritic or bathyal types is like that of the upper Georgetown formation.

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[29] Burckhardt, C. Etude synthétique sur le Mésozoique mexician. **Mém. Soc. Pal. Suisse, vol. 50, p. 174, 1930.**

[30] Jukes-Browne, A. J. Cretaceous rocks of Britain, vol. 1, p. 479, 1900.

Another Albian fauna of neritic or bathyal facies is that of the region of Perte du Rhone, which is described by Koby.[32] The following are included:

Trochocyathus conulus (Phillips) 1829
Trochocyathus harveyanus E. & H. 1848
Trochosmilia lorioli Koby 1895
Epismilia robusta Koby 1895
Euhelia expansa Koby 1895

Like the English fauna, and that of the Weno and Pawpaw beds of Texas, this is a neritic fauna, lacking in reef-building types.

WALNUT FORMATION

Conditions of deposition of this formation of central Texas, which consists mostly of yellowish clay-marls with thin limestones, did not favor the growth of corals. Only four species have been found:

Coelosmilia texana (Conrad) 1857
*Orbicella ? sp.
Frechia ? boesei, n. sp.
Frechia ? shumardi, n. sp.

COMANCHE PEAK-GOODLAND FORMATION

The coral fauna of these formations and their equivalents consists of the following species:

1. Comanche Peak.
2. Goodland.
3. Belvidere (Champion Shell Bed).

SPECIES	1	2	3
Coelosmilia texana (Conrad) 1857	x	x	
Parasmilia ? sp.	x		
Pleurosmilia craginiana, n. sp.	x	x	
Stephanocoenia ? wintoni, n. sp.		x	
*Astrocoenia bellensis, n. sp.	x		
*Astrocoenia nidiformis Cragin	x		x
*Placohelia ? richardsi, n. sp.	x		
*Favoidoseris fredericksburgensis, n. sp.	x		
*Favoidioseris fredericksburgensis alta, n. var.	x		
Diploastrea hilli, n. sp.	?		
Frechia ? boesei, n. sp.			x

*Doubtfully from this horizon.

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[32] Koby, F. Monographie des Polypiers Jurassiques de la Suisse. **Mém. Soc. Pal. Suisse**, vol. 22, 1895.

This is a scattered assemblage, both geographically and stratigraphically, with the exception of those marked by the star (*) which are found at the same horizon and locality in Benn County, Texas.

EDWARDS AND KIAMICHI FORMATIONS

At least three distinct coral faunas are found within these formations, besides scattered species. One of them occurs in the Edwards in the vicinity of Austin, Texas, in the "Second Requienia bed" of R. T. Hill[33]. It was described by Roemer[34] in 1888 and contains the following species:

Coelosmilia americana Roemer 1888
Parasmilia austinensis Roemer 1888
Cladophyllia furcifera Roemer 1888
Dendrosmilia ? texana (Roemer) 1888
Pleurocora coalescens Roemer 1888

This fauna occurs with caprinids and other mollusks and probably represents a neritic facies, no reef-building types being present. Another fauna, also associated with caprinids, described in this paper, includes the following:

Adkinsella edwardsensis, n. gen. and sp.
Astrocoensia guadalupae Roemer 1849
Astrocoenia pattoni, n. sp.
Archohelia ? sp.
Orbicella edwardsensis, n. sp.
Favoidioseris fredericksburgensis, n. gen. and sp.
Diploastrea ? vaughani, n. sp.

These are reef-builders and represent a different facies from the first fauna. However, they did not produce any true reefs (bioherms), the colonies growing in scattered clumps amid the surrounding and underlying caprinids, the whole perhaps forming a biostrome. A third and less significant fauna occurs in the Kiamichi (uppermost Fredericksburg) in west Texas, with these three species:

Platycyathus scottianus, n. sp.
Coelosmilia texana (Conrad) 1856
Trochosmilia stainbrooki, n. sp.

[33] Hill, R. T. and Vaughan, T. W. Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas, with reference to the occurrence of underground waters. **Geol. Survey, Eighteenth Ann. Rep.** Pt. 2, p. 2, p. 231, 1898.

[34] Roemer, F. A. Über eine durch die Häufigkeit hippuritenartiger Chamiden ausgezeichnete Fauna der oberturonen Kreide von Texas. **Pal. Abh.**, vol. 4, no. 4, pp. 281-296 (1-15), pls. 30--33 (1-3), 1888.

The species occur also in the Walnut, Comanche Peak, and Edwards. They are associated with *Gryphaea tucumcari* and indicate clear water with no great depth.

Besides these species mentioned above, there are several others whose stratigraphic positions in the Edwards formation is more uncertain:

*Pleurosmilia craginiana, n. sp.
*Astrocoenia nidiformis Cragin 1895 ? (Devils River limestone)
Dendrogyra dumblei, n. sp.
Orbicella roemeriana, n. sp.
? Favia texana Cragin 1891
Protethmos sp.
*Placohelia ? richardsi, n. sp.

WASHITA DIVISION

This division is the uppermost of three subdivisions of the Comanchean and includes the following formations, in ascending order: Georgetown and equivalents, Del Rio and equivalents, and Buda limestone.

GEORGETOWN FORMATION

This formation and its equivalents and subdivisions are widespread throughout Texas and are upper Albian in age. Corals are uncommon in north Texas; none is known from central Texas but a small fauna of reef-building types occurs in beds of Denton age in west Texas.

Duck Creek.—Only one species, *Smilotrochus ? sp.*, has been found in these beds.

Fort Worth.—No species are known from north and central Texas, but Böse has figured two species, *Placosmilia ? bravoensis* and *P. ? mexicana,* from the equivalents of the Fort Worth beds at Cerro de Muleros, Chihuahua, Mexico.

Denton and Equivalents.—No corals have been found in the Denton beds in north and central Texas, but in Pecos County, west Texas, the middle cap rock of the mesas, which is of Denton age, contains numerous silicified specimens of reel-builders. Their condition of preservation leaves much to be desired and their identification is uncertain. Besides the five species listed below, there are at least three other species which are generically indeterminable at present, all of them being small, colonial, spherical or hemispherical colonies perhaps belonging in the *Orbicellidae* or *Oulastreidae*.

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*These may prove to be erroneously reported from this formation and may be more properly placeed in the Comanche Peak.

These species are described in this paper:

Astrocoenia sp. cf. A. pattoni n. sp.
Cyathophora ? olssoni, n. sp.
Favoidioseris pecosensis, n. sp.
Siderastrea tuckerae, n. sp.
Heterocoenia washitaensis, n. sp.

These species are indicative of relatively shallow water, but, because all of the specimens are small, true reef conditions probably did not prevail. The conditions were similar to those under which the middle Jurassic coral faunas of Cutch[35] existed. The associated fauna[36] includes echinoids, rudistids, *Nerinea*, etc.

Weno.—Platycyathus scottianus, new species, which also occurs in the Kiamichi and perhaps in the Pawpaw, and which is the only species of coral now known to range from the Fredericksburg into the Washita, is the only species known from these beds.

Pawpaw.—The following four species occur in the Pawpaw beds in north Texas:

Blagrovia palmerae, n. sp.
Platycyathus scottianus, n. sp.
Trochocyathus wintoni, n. sp.
Trochocyathus sellardsi, n. sp.

All are simple types, indicative of shallow water conditions unsuited for reef corals.

Del Rio Formation and Equivalents (*Cenomanian*).—No corals are known from the Del Rio proper, but in the Main Street beds, which are the equivalent of the lower Del Rio in north and west Texas, in the Fort Stockton area, (upper cap rock), compound corals[37], associated with rudistids, caprinids, *Actaeonella, Nerinea,* etc., occur. Only one specimen of the corals, described in this paper as *Orbicella pecosensis,* new species, has been examined by the author. This coral, in contrast to those of the middle cap rock, is not silicified and the structure is well preserved.

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[35] Gregory, J. W. The corals; Jurassic Fauna of Cutch. **Pal. Indica,** ser. 2, vol. 9, pt. 2, p. 4, 1900.

[36] Adkins, W. S. Geology and mineral resources of the Fort Stockton quadrangle. **Univ. of Texas. Bull.** 2738, p. 46, 1927.

[37] Adkins, W. S. op. cit., p. 48.

In north Texas the Grayson beds are the equivalent of the Del Rio. Two species of simple corals from these beds are described herein:

Trochocyathus sellardsi graysonensis, n. var.
Parasmilia graysonensis, n. sp.

Buda Limestone.—This limestone forms the top of the Comanchean Series in Travis, Williamson, and Bell Counties, Texas, and is Cenomanian in age. Corals are not uncommon in the Buda at its various outcrops in Travis and Williamson Counties, many of them occurring in the upper part of the lower beds where there is a fairly definite horizon at which they are found. Most of the species are ahermatypic simple corals which grew either at a considerable depth or on a submerged bank where reef conditions did not prevail. The latter is more probable, for the presence of species of *Orbicella, Thamnasteria Dimorphastrea,* and *Dimorpharea,* normally shoal-water corals, indicates a shallow sea. Of the 21 species now known to occur in the Buda, 15 are found in the lower beds and 8 in the upper, 3 of the species ranging through the lower and upper. The fauna of the lower beds is of a shallow water facies, whereas the fauna of the upper beds seems to indicate deeper water because of the absence of reef-building types.

In general the Buda coral fauna has some affinities with those of the Cenomanian in England and Europe, but the similarity is not striking, and on the other hand, there is no evidence to support an idea that the Buda coral fauna has descended from those of the underlying formations of the Washita Division. It is likely that when the corals of the Cenomanian of Mexico[39] are studied a source for the Buda species may be found. Five species from this formation have already been described by Vaughan[40]. The type specimens of these species, which are in the National Museum, have been examined by the author and the following is a summary of the present disposition of Vaughan's species:

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[39] Burckhardt, C. Etude synthétique sur le mésozoique mexician. **Mém. Soc. Pal. Suisse,** vol. 50, p. 199, 1930. Orizaba Region, Mexico.

[40] Vaughan, T. W. The corals of the Buda limestone. **U. S. Geol. Survey, Bull.** 205, pp. 38-40, pls. 26-27, 1903.

Vaughan, 1903	Wells, 1933
Parasmilia texana	Placotrochus texanus
Trochosmilia ? sp. indet.	Protethmos budaensis ?
Orbicella ? texana	Orbicella ? texana
Leptophyllia sp. no. 1	Leptophyllia sp. no. 1
Leptophyllia sp. no. 2	Leptophyllia sp. no. 2

Below is a complete list of the corals of the Buda limestone and their distribution:

1. Lower beds. 2. Upper beds.

SPECIES	1	2
Placotrochus texanus (Vaughan)	x	x
Ceratotrochus ? sp.	x	
Caryophyllia comanchei n. sp.		x
Pleurosmilia saxi-fisi n. sp.	x	x
Pleurosmilia whitneyi n. sp.	x	
Pleurosmilia quaylei n. sp.	x	
Budaia travisensis, n. gen. and sp.	x	x
Stephanocoenia ? sp.	?	
Astrocoenia budaensis, n. sp.	?	
Orbicella ? texana Vaughan	?	
Trochoseris shattucki n. sp.	x	
Stephanomorpha ? saxi-rotundi n. sp.	x	
Thamnasteria hoffmeisteri, n. sp.	x	
Dimorphastrea stantoni, n. sp.	x	
Protethmos budaensis, n. sp.	x	
Leptophyllia sp. no. 1 Vaughan		?
Leptophyllia sp. no. 2 Vaughan		?
Leptophyllia sp. no. 3		?
Frechia ? sp.		x
Paracyclolites bakerae, n. gen. and sp.	x	
Dimorpharaea manchacaensis, n. sp.	x	

UPPER CRETACEOUS

Corals are not as abundant in the upper Cretaceous of North America as in the lower Cretaceous. Few large faunas of any one age have been found, but the scattered species within a formation often have a wide geographical range. Corals of the reef-building type are found only in the West Indian and Mexican regions where there are deposits made at a considerable distance from land. In the United States the upper Cretaceous beds were deposited in shallow water near the shore of the existing land areas and compact limestones of deeper water facies are unusual. The corals are principally those of the so-called "deep-sea" type[41] which may flourish in situations not tolerated by the reef builders.

AREAS OUTSIDE OF THE UNITED STATES

West Indies.—The corals from the Cretaceous of the West Indies were described first by Duncan[42] from Jamaica. The Cretaceous corals of this island were later the subject of a paper by Vaughan[43]. The author has recently completed a paper based on the Trechmann and Matley Collections in the United States National Museum, in which a revised list of the Jamaican upper Cretaceous corals is presented as follows:

*Trochocyathus matleyi Wells 1932 (MS)
Dichocoenia trechmanni Wells 1932 (MS)
Rhabdophyllia quaylei Wells 1932 (MS)
Leptoria conferticostata Vaughan 1899
Trochoseris catadupensis Vaughan 1899
Centrastrea hilli Wells 1932 (MS)
Vaughanoseris catadupensis Wells 1932 (MS)
Favioseris anomalos Wells 1932 (MS)
Diplaraea ? boltonae Wells 1932 (MS)
*Cyclolites jamaicaensis Wells 1932 (MS)
Paracycloseris elizabethae Wells 1932 (MS)
Synastrea ? adkinsi Wells 1932 (MS)
Prodiploastrea schindewolfi Wells 1932 (MS)
Multicolumnastrasa cyathiformis (Duncan) 1865
Goniopora reussiana (Duncan) 1865
Goniopora trechmanni Wells 1932 (MS)

*These two species occur in beds of a different facies from the remainder which consists of hermatypic corals which occur in a rudistid limestone.

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[41] The term "deep-sea" corals is unfortunate, because there is no real distinction between corals found in bathyal and neritic environments, with the exception of the true reef corals which are exclusively neritic. The term **hermatypic,** from **herma,** a reef, is therefore proposed to describe corals of the reef-building type, the living species of which possess symbiotic zooxanthellae within their tissues. In contrast to this term, **ahermatypic** is proposed to describe the corals of the non-reef-building type, the living forms of which do not possess zooxanthellae and which live under greatly varying conditions of depth, temperature, and light. The use of these terms eliminates the inaccurate expression "deep-sea corals." Ahermatypic corals include both the deep (bathyal) and shallow (neritic) water forms which do not build reefs.

[42] Duncan, P. M. and Wall, G. P. Notice of the geology of Jamaica with descriptions of Eocene, Cretaceous, and Miocene corals. **Quart. Jour. Geol. Soc. London,** vol. 21, pp. 1-15, pls. 1-2, 1865.

[43] Vaughan, T. W. Some Cretaceous and Eocene corals from Jamaica. **Mus. Comp. Zool., Bull.,** vol. 34, pp. 227-250, 255-256, pls. 36-41, 1899.

All of these species except those starred, are from beds which are probably Maestrichtian in age and which can be correlated with beds in Curacao (Seroe Teintje limestone) and Mexico ("Cardeñas beds"). The absence of species closely related to those of the continental upper Cretaceous is at once perceived, and it is evident that the West Indian area and eastern Mexico were regions inhabited by coral faunas differing from those of more northerly areas. The latter were of a type suited to a neritic environment, as evidenced by the lack of any reef-builders, whereas the larger West Indian faunas, with their reef corals, represent a more tropical situation on submarine shoals swept by currents. This more southerly fauna is associated with rudistids of the genera *Barrettia, Prebarrettia, Biradiolites, Lapeirousia, Titanosarcolites,* and *Antillocaprina.*

The upper Cretaceous rudistid fauna is found in Cuba[44] but no corals have been noted. The rudistid fauna has also been found in the Dominican Republic, St. Croix, and Haiti[45]. From the last country Woodring reports *Actinacis* ? sp. at station 9639 in the Arrondissement of Nippes.

The same fauna has been found in the island of Curacao, which is not, strictly speaking, one of the West Indies, but which should be considered here. Gerth [46] lists the following species from the Seroe Teintje limestone:

Astrocoenia sp. cf. A. ramosa E. & H.
Astrocoenia sp. near A. faujasi
Rhabdophyllia sp.
Goniastrea curasavica Gerth 1928
Astrarea sp. cf. A. multiradiata (Reuss) 1854
Actinacis ? sp.
Multicolumnastraea parvula Gerth 1928
Alveopora molengraffi Gerth 1928

On the basis of these corals, Gerth assigns a lower Senonian age to this limestone, a conclusion accepted by MacGillavry[47]; but modified by the statement that "the age certainly is Senonian,

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[44] Sanchez-Roig, M. La fauna Cretacica de la region central de Cuba. **Mem. Soc. cub. Hist. nat. "Felipe Poey,"** vol. 7, pp. 83102, pls. 1-10, 1926.

[45] Woodring, W. P., Brown, J. S., and Burbank, W. S., Geology of the Republic of Haiti, p. 97, 1924.

[46] Gerth, H. Beitr. z. Kenntn. der Mesozoischen Korallenfauna vun Südamerika. **Leidsche Geol. Meded.,** vol. 3, pp. 1-5, pl. 1, 1928.

[47] MacGillavry, H. J. Rudistid fauna of Seroe Teintje **Kon. Akad. Wetens. Amsterdam,** Proc. vol. 35, no. 3, p. 390, 1932.

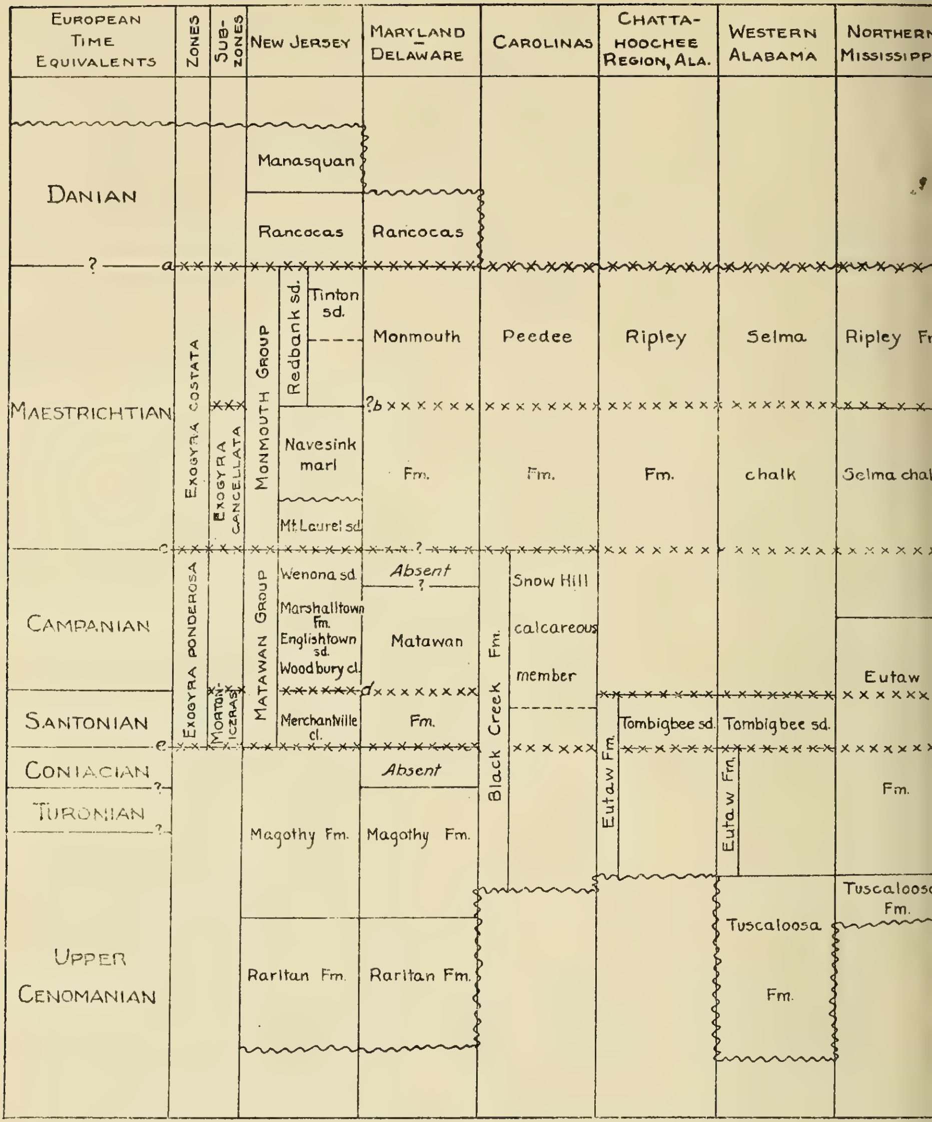
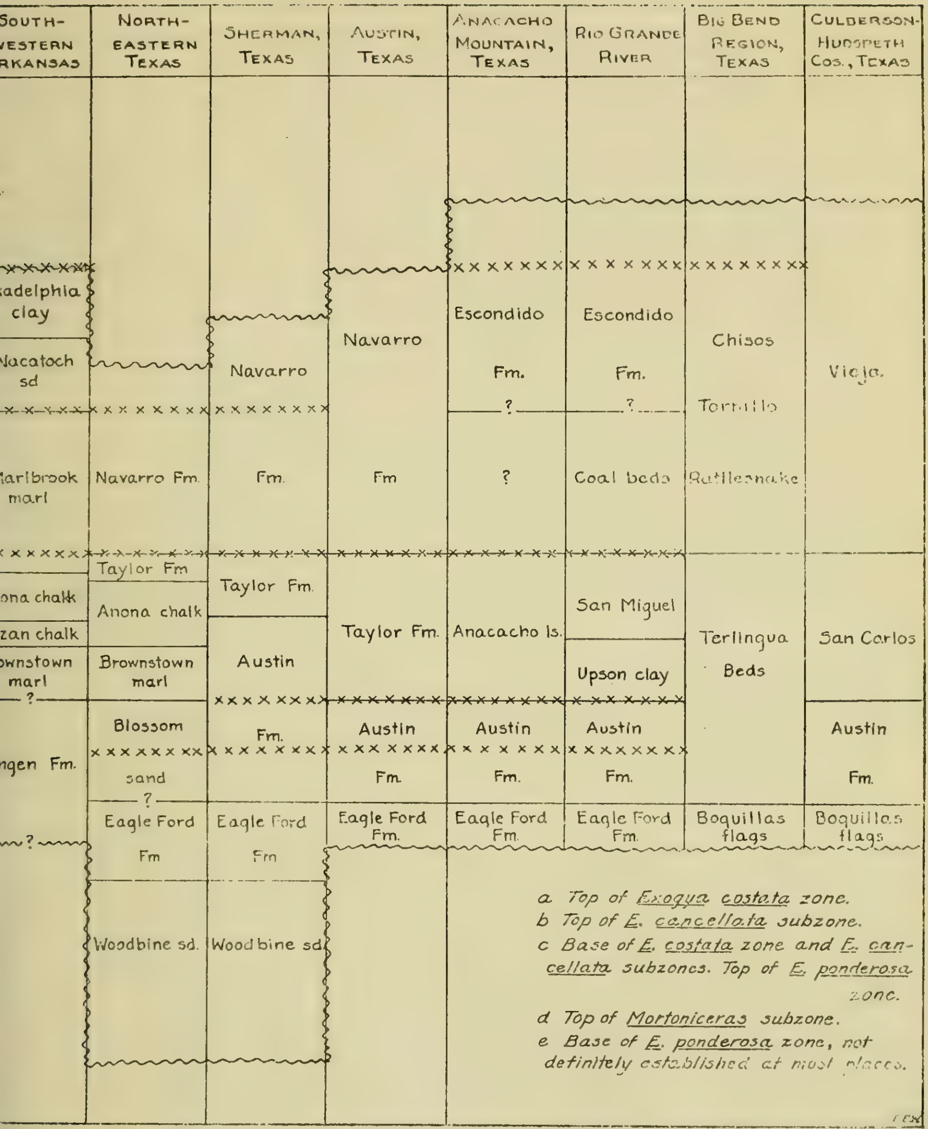

European Time Equivalents
Zones
Sub-zones
New Jersey
Maryland – Delaware
Carolinas
Chattahoochee Region, Ala.
Western Alabama
Northern Mississipp
Danian
Manasquan
Rancocas
Rancocas
?
a
Maestrichtian
Exogyra costata
Exogyra cancellata
Monmouth Group
Redbank sd.
Tinton sd.
Monmouth
Peedee
Ripley
Selma
Ripley Fr
?b
Navesink marl
Fm.
Fm.
Fm.
chalk
Selma chal
Mt. Laurel sd.
c
?
Campanian
Exogyra ponderosa
Matawan Group
Wenona sd.
Absent
?
Marshalltown Fm.
Englishtown sd.
Woodbury cl.
Matawan
Black Creek Fm.
Snow Hill calcareous member
Eutaw
Santonian
Mortoniceras
d
Merchantville cl.
Fm.
Tombigbee sd.
Tombigbee sd.
e
Coniacian
?
Absent
Fm.
Eutaw Fm.
Eutaw Fm.
Turonian
?
Magothy Fm.
Magothy Fm.
Tuscaloosa Fm.
Upper Cenomanian
Raritan Fm.
Raritan Fm.
Tuscaloosa Fm.

Fig. 2. Correlation of Upper Cretaceous Forma

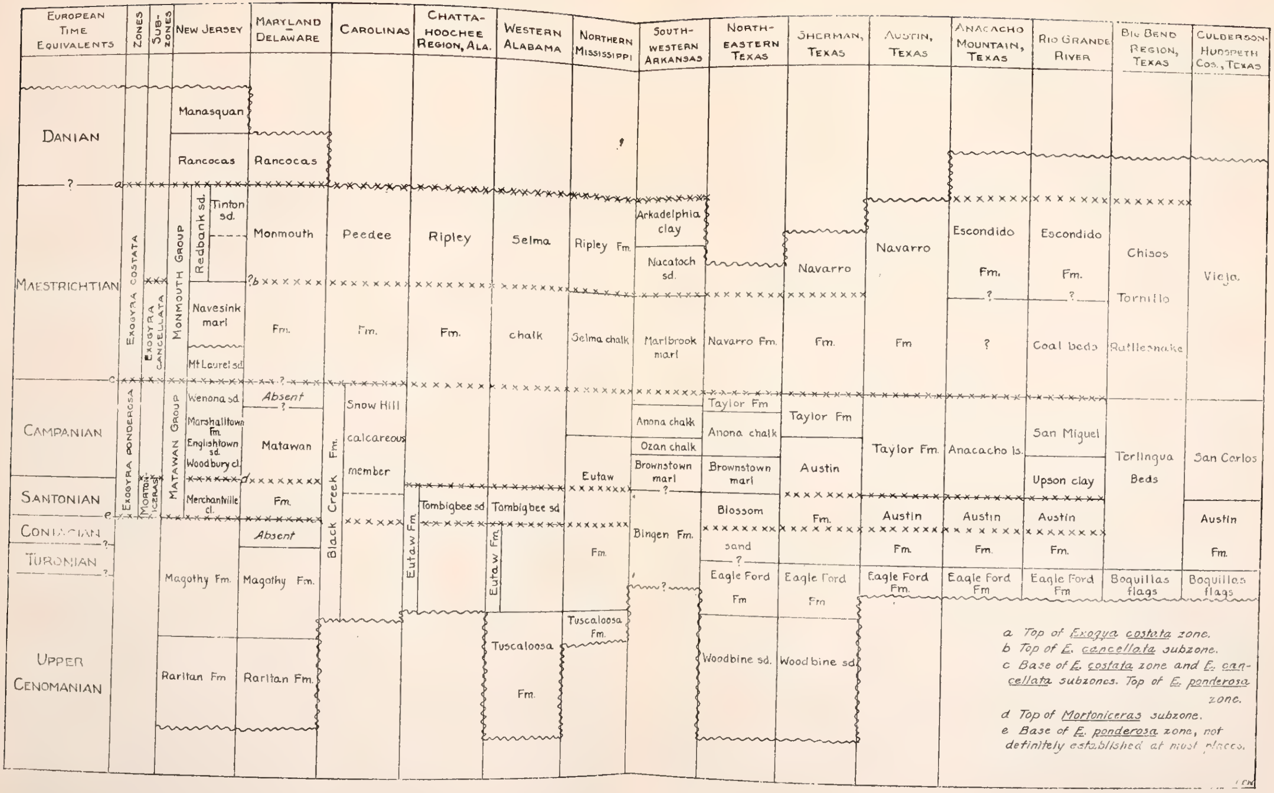
Adapted from


SOUTH-WESTERN ARKANSAS
NORTH-EASTERN TEXAS
SHERMAN, TEXAS
AUSTIN, TEXAS
ANACACHO MOUNTAIN, TEXAS
RIO GRANDE RIVER
BIG BEND REGION, TEXAS
CULBERSON-HUDSPETH COS., TEXAS
adelphia clay
Nacatoch sd
Marlbrook marl
ona chalk
zan chalk
ownstown marl
?
ngen Fm.
?
Navarro Fm.
Taylor Fm
Anona chalk
Brownstown marl
Blossom sand
?
Eagle Ford Fm
Woodbine sd.
Navarro Fm.
Taylor Fm.
Austin Fm.
Eagle Ford Fm
Woodbine sd
Navarro Fm
Taylor Fm.
Austin Fm.
Eagle Ford Fm.
Escondido Fm.
?
?
Anacacho ls.
Austin Fm.
Eagle Ford Fm.
Escondido Fm.
?
Coal beds
San Miguel
Upson clay
Austin Fm.
Eagle Ford Fm.
Chisos
Tornillo
Rattlesnake
Terlingua Beds
Boquillas flags
Vieja.
San Carlos
Austin Fm.
Boquillas flags

a Top of *Exogyra costata* zone.
b Top of *E. cancellata* subzone.
c Base of *E. costata* zone and *E. cancellata* subzones. Top of *E. ponderosa* zone.
d Top of *Mortoniceras* subzone.
e Base of *E. ponderosa* zone, not definitely established at most places.

NS OF THE ATLANTIC AND GULF COASTAL REGIONS.

PHENSON, 1923.


European Time Equivalents
Zones
Sub-zones
New Jersey
Maryland Delaware
Carolinas
Chattahoochee Region, Ala.
Western Alabama
Northern Mississippi
Southwestern Arkansas
Northeastern Texas
Sherman, Texas
Austin, Texas
Anacacho Mountain, Texas
Rio Grande River
Big Bend Region, Texas
Culberson-Hudspeth Cos., Texas
Danian
Maestrichtian
Campanian
Santonian
Coniacian
Turonian
Upper Cenomanian
Exogyra costata
Exogyra cancellata
Exogyra ponderosa
Mortoniceras
Manasquan
Rancocas
Monmouth Group
Redbank sd.
Tinton sd.
Navesink marl
Mt Laurel sd
Matawan Group
Wenona sd
Marshalltown Fm.
Englishtown sd.
Woodbury cl.
Merchantville cl.
Magothy Fm.
Raritan Fm
Rancocas
Monmouth Fm.
Absent
Matawan Fm.
Absent
Magothy Fm.
Raritan Fm.
Peedee Fm.
Black Creek Fm.
Snow Hill calcareous member
Ripley Fm.
Eutaw Fm.
Tombigbee sd
Selma chalk
Tombigbee sd
Eutaw Fm.
Tuscaloosa Fm.
Ripley Fm
Selma chalk
Eutaw Fm.
Tuscaloosa Fm.
Arkadelphia clay
Nacatoch sd.
Marlbrook marl
Anona chalk
Ozan chalk
Brownstown marl
Bingen Fm.
Navarro Fm.
Taylor Fm
Anona chalk
Brownstown marl
Blossom sand
Eagle Ford Fm
Woodbine sd.
Navarro Fm.
Taylor Fm
Austin Fm.
Eagle Ford Fm
Woodbine sd
Navarro Fm
Taylor Fm.
Austin Fm.
Eagle Ford Fm.
Escondido Fm.
?
Anacacho ls.
Austin Fm.
Eagle Ford Fm
Escondido Fm.
Coal beds
San Miguel
Upson clay
Austin Fm.
Eagle Ford Fm
Chisos
Tornillo
Rattlesnake
Terlingua Beds
Boquillas flags
Vieja
San Carlos
Austin Fm.
Boquillas flags
?
a
b
c
d
e

a Top of Exogyra costata zone.
b Top of E. cancellata subzone.
c Base of E. costata zone and E. cancellata subzones. Top of E. ponderosa zone.
d Top of Mortoniceras subzone.
e Base of E. ponderosa zone, not definitely established at most places.

FIG. 2. CORRELATION OF UPPER CRETACEOUS FORMATIONS OF THE ATLANTIC AND GULF COASTAL REGIONS.

ADAPTED FROM STEPHENSON, 1923.

probably Campanian or even Maestrichtian".

Mexico.—The Cardeñas beds in San Louis Potosi contain a rudistid fauna similar to that of the West Indies and are referred to the Santonian by Burchardt[48] but they are probably Maestrichtian. They contain besides the rudistids, *Exogyra costata,* and other species of mollusks, the following indicated species of corals which will be the subject of a separate paper by the author:

Cladocora sp. cf. C. jamaicaensis Vaughan
Pleurocora n. sp.
Dactylosmilia ? n. sp.
Placocoenia ? n. sp.
Leptoria n. sp. aff. L. conferticostata Vaughan
Felixastraea ? n. sp.
Trochoseris ? n. sp.
Metethmos n. sp.
Paracyclolites sp. aff. P. elizabethae Wells (MS)
Synastrea n. sp.
Actinacis n. sp.
Astreopora ? n. sp.

It is significant that the Cardeñas beds contain a fauna related both to the West Indian and Gulf Coastal plain areas.

Canada.—No corals are known from the upper Cretaceous formations of Canada. In the Western Interior region the deposits are similar to those of that area in the United States. On Vancouver Island the Nanaimo group, of Maestrichtian age, consists of marine deposits of shales and conglomerates of littoral facies.

AREAS WITHIN THE UNITED STATES

It is convenient to discuss the distribution of the upper Cretaceous corals of these areas under three headings with reference to the three regions undergoing deposition of sediments during this period. These regions are (1) the Atlantic and Gulf Coastal Plains, (2) the Western Interior, and (3) the West Coast. The first two regions were connected by a seaway in the southwestern United States and northern Mexico, the last was separated from both throughout this time.

Atlantic and Gulf Coastal Plains.—The correlation of the upper Cretaceous deposits of this extensive region is shown in Fig. 2, adapted from Stephenson[49]. All the corals are found in the *Exogyra ponderosa* and *E. costata* Zones[50] (Santonian-Maestrichtian). None are known from the Raritan and Magothy formations (Cenomanian) of New Jersey, Delaware, and Maryland, nor from the Tuscaloosa formation of Alabama and Mississippi and the Woodbine and Eagle Ford of Texas. These formations are composed of thin arenaceous limestones, sands and clays, representing an environment not congenial to corals of any sort. During the period represented by the two paleontologic zones mentioned above, conditions improved and neritic corals established themselves in different areas at various times.

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[48] Burchardt, C. Etude synthétique sur le Mésozoique mexicain. **Mém. Soc. Pal. Suisse,** vol. 50,, p. 233, 1930.

[49] Stephenson, L. W. The Cretaceous formations of North Carolina, Pt. 1, invertebrate fossils of the upper Cretaceous formations. **North Carolina Geol. and Econ. Survey,** vol. 5, pt. 1, p. 36, 1923.

Exogyra ponderosa Zone.—This zone, established by Stephenson, contains in its lower part the *Mortoniceras* sub-zone, and in this latter appears the first coral, an indeterminate specimen from the Blossom sand of northeastern Texas (Plate 14, fig. 24). In the upper part of this zone appears a larger coral fauna, distributed as follows:

SPECIES	FORMATION	REGION
Trochocyathus woolmani Vaughan, 1900	Woodbury clay, Matawan form.	N. J.
Trochocyathus taylorensis, n. sp.	Lower Taylor	Tex.
Trochocyathus mississippiensis, n. sp.	Selma	Miss.
Parasmilia ? balanophylloides Bölsche, 1870	Marshalltown, Matawan form.	N. J.
Hindesastraea collinensis Hoffmeister, 1929	Wolfe City sand, Taylor form.	Tex.
Siderastrea cretacea (Bölsche) 1870	Marshalltown, Matawan form.	N. J.
Micrabacia cribraria Stephenson, 1916	Woodbury clay?	N. J.
Micrabacia taylorensis, n. sp.	Lower Taylor	Tex.
Micrabacia stephensoni, n. sp.	Upper Taylor	Tex.
Micrabacia arkansasensis, n. sp.	Upper Marlbrook	Ark.

Only two of these species, *T. woolmani* and *S. cretacea*, extend into the overlying *E. costata* zone. The fauna as a whole is scattered and is indicative of the neritic facies. It may well be compared with the coral fauna of beds of the same age (*Actinocamax quadratus* zone) in England, which, according to Jukes-Browne[51], consists of the following ahermatypic species:

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[50] Stephenson, L. W. Cretaceous deposits of the eastern Gulf region and species of Exogyra from the eastern Gulf region and the Carolinas. U. S. Geol. Survey, Prof. Paper 81, 1914.

Onchotrochus serpentinus Duncan
Caryophyllia cylindracea Reuss
Coelosmilia granulata Duncan
Coelosmilia laxa E. & H.
Coelosmilia regularis Tomes
Parasmilia centralis (Mantell)
Parasmilia centralis var. graveseana E. & H.
Parasmilia centralis var. mantelli E. & H.
Parasmilia fittoni E. & H.
Parasmilia granulata Duncan
Diblasus grevensis Lonsdale
*Micrabacia numismalis (Tomes)

In this fauna, members of the *Trochosmiliidae* are preponderant, in contrast to their relative scarcity in the *E. ponderosa* zone of the United States. The English fauna is supposed to have lived in deeper water (500 + fathoms?) than the American.

Exogyra costata Zone.—This zone, Maestrichtian in age, contains a large and scattered coral fauna, distributed from Texas to New Jersey. In many cases the position of the species in the zone is uncertain and for that reason no attempt has been made to subdivide the fauna at present.

SPECIES	FORMATION	REGION
Trochocyathus woolmani Vaughan, 1900	Navarro;	Tex.
	E. cancellata zone, Ripley	Ga.
Platytrochus vaughani (Stephenson), 1916	Monmouth	Md.
Trochocyathus gardnerae, n. sp.	Upper Navarro	Tex.
Steriphonotrochus manorensis, n. sp.	Middle Navarro	Tex.
Caryophyllia stephensoni, n. sp.	Upper Navarro	Tex. Ark.
Caryophyllia mississippiensis, n. sp.	Lower Selma	Miss.
Paracyathus ? vaughani Weller, 1907	Navesink	N. J.

*Described as *Stephanophyllia* by Tomes.

[51] Jukes-Browne, A. J. Cretaceous Rocks of Britain, vol. 3, pp. 503-504, 1904.

Dasmosmilia reesidei, n. sp.	Selma; Navarro	Miss. Tex.
Hindesastraea discoidea White, 1888	Navarro	Tex.
Siderastrea cretacea Bölsche, 1870	Basal Navarro	Tex.
Wadeopsammia nodosa (Wade), 1926	Ripley	Tenn.
Micrabacia hilgardi Stephenson, 1916	Ripley	Tenn. Ala., Miss.
Micrabacia hilgardi occidentalis, n. var.	Navarro; Nacatoch	Tex. Ark.
Micrabacia marylandica Stephenson, 1916	Monmouth	Md.
Micrabacia mineolensis Stephenson, 1916	Upper Navarro	Tex.
Micrabacia mississippiensis Stephenson, 1916	Ripley	Miss.
Micrabacia rotatilis Stephenson, 1916	Monmouth	Md.
Micrabacia rotatilis georgiana Stephenson, 1916	Upper Ripley	Ga.
Micrabacia navarroensis, n. sp.	Upper Navarro	Tex.

This fauna, consisting of 17 species and 2 varieties, is notable for the remarkable development of the species of *Micrabacia,* of which there are 6 species and 2 varieties, distributed from New Jersey to Mexico. It is a large fauna and compares with those of equivalent age in Europe. Like that of the *E. ponderosa* Zone, it is of neritic facies, and distinct from that of the hermatypic fauna which flourished at the same time in the West Indies and Mexico. Its environment was that of the relatively shallow water of the neritic zone near shore. The bathymetric ranges of the genera in this fauna which are still living are of interest here for comparison:

Trochocyathus	100-750 fathoms

Paracyathus	shallow water	to 750	"
Caryophyllia	shallow water	to 1000	"
Dasmosmilia		70-150	"
Siderastrea	shallow water		
*Micrabacia		190-225	"

All of the above genera may live in fairly shallow water although some extend below the depth of the margin of the continental shelf. Again comparing an American fauna with the English one corresponding to it in age, we find the following species listed from the *Belemnites mucronatus* zone by Jukes-Browne[52]:

Onchotrochus serpentinus Duncan
Caryophyllia cylindracea Reuss
Trochosmilia sp. 2
Coelosmilia cylindrica Duncan
Coelosmilia granulata Duncan
Coelosmilia laxa E. & H.
Coelosmilia wiltshirei Duncan
Parasmilia centralis (Mantell)
Parasmilia centralis var. mantelli E. & H.
Parasmilia cylindrica E. & H.
Parasmilia fittoni E. & H.
Diblasus grevensis Lonsdale
Stephanophyllia michelini Lonsdale

This fauna, like that of the *Actinocamax quadratus* zone, is also of a deeper water facies than the American one, and a majority of its species are Trochosmiliids.

Neilsen[53] has described a small coral fauna from the Maestrichtian of Denmark consisting of these six species:

Trochocyathus hemisphericus Nielsen 1922
Coelosmilia ponderosa (Forch. & Steenstr.) Neilsen 1922
Coelosmilia excavata (von Hagenow) 1839
Parasmilia biseriata (Forch. & Steenstr.) Nielsen 1922
Parasmilia cincta Nielsen 1922
Parasmilia cylindrica Nielsen 1922

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*Based upon the ranges of *Stephanophyllia fungulus* Alcock and *S. complicata Moseley*, species which probably belong to *Micrabacia*.

[52] Jukes-Browne, A. J. op. cit., pp. 503-504, 1904.

[53] Brünnich-Nielsen, K. Zoantharia from Senone and Paleocene deposits in Denmark and Skaane. **D. Kgl. Danske Vidensk. Selsk. Skrifter,** (8), 5, 3, 1922

This fauna is distinct from that of the Maestrichtian of England and France; the two have no species in common. The Maestrichtian at the type locality in Holland contains a third distinct fauna which has been described by Umbgrove[54]. This last, of hermatypic species, is of a facies similar to that found in Jamacia, Curacao, and Mexico.

Western Interior.—A table of correlation of the formations in this area, adapted from Reeside[55], is presented by Fig. 3. Corals are uncommon in this region and must have migrated northwards from Mexico and the West Indies. Conditions for the most part did not favor their growth or spread. The few known species are scattered through the section but individuals of one species are plentiful at certain horizons. In presenting a list of the species and their stratigraphic distribution I think it best to consider the latter on the basis of the European time scale:

SPECIES	AGE AND HORIZON	REGION
Trochocyathus egerius (White)	Maestrichtian: Pierre sh., Lewis sh.	N. Mex. Colo. S. Dakota
Trochosmilia moorei, n. sp.	Turonian: Basal Mancos.	Utah
Archohelia dartoni, n. sp.	Turonian: Carlile zone, Mancos sh.	N. Mex.
Micrabacia americana, Meek	U. Campanian-Maestrichtian: Cliff House ss. U. Pierre sh. Fox Hills ss.	N. Mex. Mont., S. Dakota
Micrabacia americana multicosta, Stephenson	Maestrichtian: Fox Hills ss. ?	Mont.

One species has been reported from the Lincoln marble horizon (Turonian) of the Benton group of Kansas. This is *Astrocoenia conica* Logan[56], (Field Mus. No. P 5946), represented by

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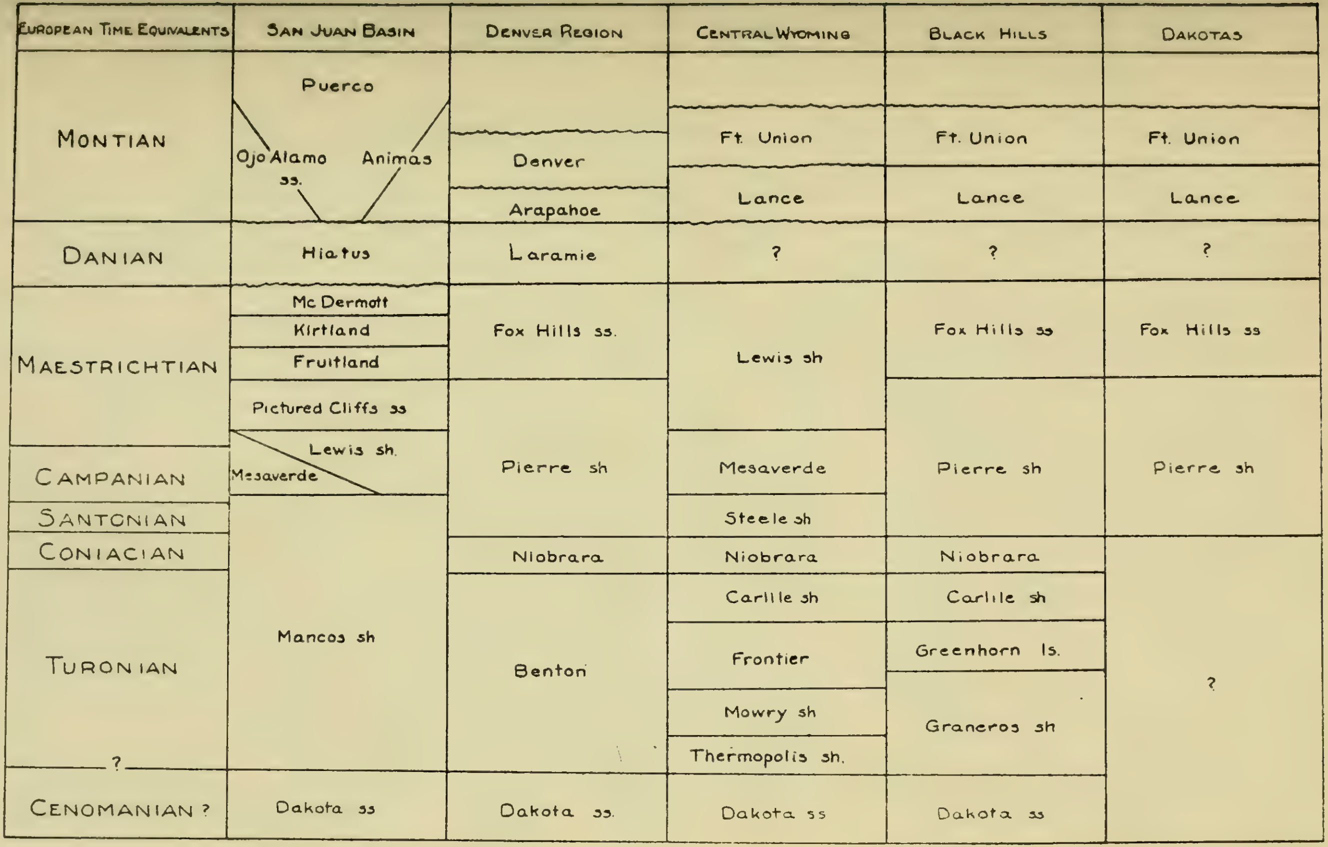
[54] Umbgrove, J. H. F. De Anthozoa uit het maastrichtsche Tufkrift. **Leidsche Geol. Meded.**, vol. 1, no. 1, pp. 83-126, pls. 8-11, 1925.

[55] Reeside, J. B. jr. Upper Cretaceous and Tertiary formations of the western part of the San Juan Basin of Colorado and New Mexico. U. S. Geol. Survey Prof. Paper 134, pl. 4, 1924.

[56] Logan, W. N. Contributions to the paleontology of the upper Cretaceous series. **Field Col. Mus. Pub.** 36, **Geol. Ser.**, vol. 1, no. 6, p. 215, pl. xxvi, figs. 1-3, 1899.



European Time Equivalents	San Juan Basin	Denver Region	Central Wyoming	Black Hills	Dakotas
Montian	Puerco Ojo Alamo ss. Animas	Denver Arapahoe	Ft. Union Lance	Ft. Union Lance	Ft. Union Lance
Danian	Hiatus	Laramie	?	?	?
Maestrichtian	Mc Dermott Kirtland Fruitland Pictured Cliffs ss Lewis sh.	Fox Hills ss. Pierre sh	Lewis sh	Fox Hills ss Pierre sh	Fox Hills ss Pierre sh
Campanian	Mesaverde		Mesaverde		
Santonian	Mancos sh		Steele sh		
Coniacian		Niobrara	Niobrara	Niobrara	?
Turonian		Benton	Carlile sh Frontier Mowry sh Thermopolis sh.	Carlile sh Greenhorn ls. Graneros sh	
?					
Cenomanian ?	Dakota ss	Dakota ss.	Dakota ss	Dakota ss	

Fig. 3 Correlation of the Upper Cretaceous Deposits of Western Interior United States

a worn holotype. As Logan notes, the "generic characters are doubtful". The author has not had the opportunity of seeing the specimen, but from Logan's poor figures and sketchy description, it is concluded that the species is not an *Astrocoenia*.

West Coast.—For our slight knowledge of the upper Cretaceous corals of this area we must refer to a short paper by Nomland[57], in which are found descriptions of the following species:

Haimesastraea petrosa, (Gabb)
Trochosmilia ? granulifera, Gabb
Trochocyathus oregonensis, Nomland
Trochocyathus pergranulatus, Nomland

Except for the first species, the horizon of which is doubtfully Cretaceous, the corals occur in the comprehensive Chico series and are very poorly preserved.

UPPER CRETACEOUS OR EOCENE

Under this heading I include two small coral faunas of Eocene rather than upper Cretaceous aspect but which have been referred to the Cretaceous by some authors. They occur in the Western Interior (Cannonball marine member, Lance formation) and in New Jersey (Rancocas and Manasquan formations).

CANNONBALL MARINE MEMBER, LANCE FORMATION

Six species of corals have been described by Vaughan[58] from the Cannonball marine member of the Lance formation of North Dakota. The species, all represented by holotypes, are:

Trochocyathus dakotaensis Vaughan, 1920	(U.S.N.M.No.32374)
Trochocyathus neumani Vaughan, 1920	(” 32375)
Paracyathus lloydi Vaughan, 1920	(” 32376)
Paracyathus thomi Vaughan, 1920	(” 32377)
Paracyathus kayserensis Vaughan, 1920	(” 32378)
Steriphonotrochus leithensis Vaughan, 1920	(” 32379)

These have been fully described and illustrated by Vaughan and are not further discussed in this paper.

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[57] Nomland, J. O. Corals from the Cretaceous and Tertiary of California and Oregon. **Univ. of California, Pub., Geol.**, vol. 9, no. 5, pp. 59-76, pls. 3-6, 1916.

[58] Vaughan, T. W. Corals from the Cannonball member of the Lance formation. **U. S. Geol. Survey Prof. Paper** 128-A, pp. 61-64, pl. 10, 1920.

There is a question whether the Lance formation is Cretaceous or Tertiary in age. Stanton[59] believes it to be upper Cretaceous and says:

> Its fauna is strictly marine and includes 2 species of Foraminifera, 6 of corals, 60 of mollusks, and 2 of sharks. While its molluscan fauna has a modern aspect, on account of the lack of ammonoids and other distinctly Mesozoic groups, it is connected with the preceding late Cretaceous faunas of the same region by the specific identity of 40 per cent of its species. No Eocene species have been identified in it except one from the Fort Union.
>
> Geographically and historically the Cannonball member is much more closely connected with the Cretaceous than with the Eocene, for the reason that it is in the midst of an area that was covered by the sea practically throughout upper Cretaceous time, while it is a thousand miles distant from recognized Eocene deposits.
>
> The conclusion is therefore reached that the Cannonball marine member and consequently the whole of the Lance formation is of Cretaceous age.

Vaughan, in the paper cited, notes that the "corals afford no basis for an inference as to the precise age of the sediments in which they were imbedded, for they might be either of Tertiary or Cretaceous age". The present author would point out that although *Trochocyathus* and *Steriphonotrochus* may be either Cretaceous or Tertiary, *Paracyathus,* with the exception of a very dubious species from the Navesink marl of New Jersey, (*P. vaughani,* Weller), is known only from the Tertiary and Recent.

RANCOCAS AND MANASQUAN FORMATIONS OF NEW JERSEY

These are the youngest beds of the Cretaceous exposed in the Atlantic and Gulf coastal plain areas except the higher beds of the Escondido of Texas. It is more than likely that they are early Eocene in age. Evidence towards the latter view is afforded by the coral fauna. According to Weller[60], this fauna consists of the following species:

Flabellum mortoni, Vaughan 1900. (Hornerstown & Manasquan marls).
Trochocyathus conoides, Gabb 1860. (Manasquan marl).
Balanophyllia inauris, Vaughan 1900. (Manasquan marl).

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[59] Stanton, T. W. The fauna of the Cannonball marine member of the Lance formation. **U. S. Geol. Survey Prof. Paper** 128-A, p. 18, 1920.

[60] Weller, S. Cretaceous Paleontology of New Jersey, pp. 267-270, 272-273; pl. 5, figs. 1-4, 8-10, 18-22, 1907.

Although *Trochocyathus* may indicate an either Cretaceous or Tertiary age, *Flabellum* and *Balanophyllia* are not known from formations older than Tertiary. In time, the New Jersey formations may be contemporaneous with the Lance formation of the Western Interior and represent with the Lance the transition from Cretaceous to Eocene (Danian?).

Besides the three species listed above there should be included *Trochosmilia ? inauris* Bölsche[61] from the Vincentown limesand of Brownville, N. J. It is possible that this species is conspecific with *Turbinolia inauris* Morton[62], but as Vaughan[63] pointed out, Morton never described his species and published only a very poor figure and the species had better lapse. Another species which is unrecognizable is *Anthophyllum atlanticum* Morton[64], also from the Vincentown limesand.

INDETERMINATE MATERIAL

FROM THE UPPER CRETACEOUS

Much of the material from the upper Cretaceous of the Gulf coastal plain consists of specimens of simple corals too badly preserved for determination. All of them are preserved as mud casts of the interior, showing, in some cases, the septa, but almost never the exterior or the wall. Rather than make some very doubtful generic assignments I have not described the material with the hope that better specimens will be found.

The following is a list of the species left indeterminate, according to the formations from which they were collected:

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[61] Bölsche, W. Polypi. In: Credner, H. Die Kreide von New Jersey. **Zeitschr. deutsch. geol. Ges.**, vol. 22, p. 215, 1870.

[62] Morton, S. G. Syopsis of the organic remains of the Cretaceous group of the United States. Philadelphia. p. 81, pl. 15, fig. 11, 1834.

[63] Vaughan, T. W. Eocene and Lower Oligocene Coral Faunas of the United States—. **U. S. Geol. Survey Mon.** 39, p. 171, 1900.

[64] Morton, S. G. op. cit., p. 80, pl. 15, figs. 9, 10.

FORMATION	LOCALITY	NO. OF SPECIES
Blossom sand	Lamar Co., Tex.	1
Ozan marl	Sevier Co., Ark.	1
Anona chk.	Arkansas	1
Wolf City sd.	Collin Co., Tex.	1
Basal Selma	Alabama	2
Selma chk.	Alabama	1
Selma chk.	Mississippi	1 (same as preceding)
Selma chk.		
E. costata zone, below *L. protexta* subzone	Alabama	2
	Mississippi	2 (1 same as preceding)
L. protexta subzone	Alabama	1
Selma chk., top	Alabama	1

SYSTEMATIC DESCRIPTIONS OF SPECIES

LOWER CRETACEOUS

Order MADREPORARIA Milne Edwards & Haime

Suborder APOROSA Milne Edwards & Haime

Family FLABELLIDÆ Bourne

Genus ADKINSELLA, n. gen.

Genotype.—*A edwardsensis.* Edwards ls. Central Texas.

Diognosis of genus.—Corallum simple, cornute, or subcylindrical. Wall epithecate as in *Gardineria, Flabellum,* and *Rhizotrochus.* Septa few in number, non-exsert, with entire margins and granulated sides. Columella absent. Dissepiments absent, but thin sheets of stereoplasma may produce a cellular thickening of wall, although there is no filling up of the corallum from the bottom. New coralla arise by internal or calicular gemmation, only one being produced at a time and occupying the entire calice so that a cylindrical corallum constricted at irregular intervals is produced.

Remarks.—This remarkably simple form, essentially consisting of only an epithecate wall and a few septa, is probably related to *Gardineria* Vaughan[65], species of which are now living in both the Atlantic and Pacific areas. It is distinguished from that genus by the lack of any columella, a condition which also separates it from *Flabellum* and *Blastotrochus*. *Rhizotrochus* E. & H. has septa which meet in the center. There are no Cretaceous genera now known which approach this unique form. *Kraterostrobilos* Crickmay,[66] from the Bajocian (Sonninian) of Ashcroft, B. C., is a simple flabellid, lacking a columella, which has five or more cycles of short, non-exsert septa. It may be related to the present form.

Adkinsella edwardsensis n. sp. Plate 1, figs. 1-4; Pl. 3, figs. 9-11

Description.—Characters as of the genus described above. The type specimen measures approximately 40 mm. in height with a maximum diameter near the top of 31 mm. The paratype is a smaller specimen, cylindrical in shape, the base being broken away, with several constrictions indicating rejuvenation due to internal gemmation, measuring 33 mm. in height with an average diameter of 20 mm. The larger specimen possesses 12 well-developed septa, six of which are larger than the rest and extend nearly to the center of the corallum. The thickening internally of the wall by stereoplasmic deposits which are continuous over the inner ends of the septa is a marked feature and produces cellular cavities when the coating is irregularly applied. The exterior of the corallum is marked by concentric growth lines in the epitheca and by shallow longitudinal grooves oposite the outer ends of the septa. The smaller specimen is similar in construction but appears to possess only 6 septa.

Type and Paratype.—In the collection of the Bureau of Economic Geology, Austin, Texas.

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[65] Vaughan, T. W. Recent Madreporaria of Hawaiian Islands and Laysan. **U. S. Nat. Mus. Bull.** 59, p. 67, 1907. Genotype: **G. hawaiiensis** Vaughan, 1907. Recent. Hawaii. By monotypy.

[66] Crickmay, C. Jurassic Rocks of Ashcroft, B. C. **Univ. of California Pub. Geol.**, vol. 19, no. 2, p. 40, 1930. Genotype: **K. bathys** Crickmay. (By monotypy).

Occurrence: *Type locality.*—Edwards limestone, Crow Ranch, Bell County, Texas.

Genus PLACOTROCHUS Milne Edwards & Haime 1848

Genotype.—*P. laevis* E. &. H. 1848. Recent. Philippines. (By subsequent designation, E. & H. 1850).

Placotrochus texanus (Vaughan) Plate 1, figs. 5-9; Pl. 3, figs. 18-25

Parasmilia texana Vaughan 1903. U. S. Geol. Survey Bull. 205, p. 37, pl. 27, figs. 1-3.
Parasmilia texana Grabau & Shimer 1909. North American Index Fossils, vol. 1, p. 99, fig. 161.
Parasmilia texana Felix 1914. Fossilium Catalogus, pars 7, p. 230.
Parasmilia texana Adkins 1928. Univ. of Texas, Bull. 2838, p. 77.
Trochosmilia ? sp. indet. Vaughan 1903. U. S. Geol. Survey Bull. 205, p. 38, pl. 27, figs. 4, 5.
Trochosmilia sp. Adkins 1928 Univ. of Texas, Bull. 2838, p. 76.

Description.—The corallum is simple, small, short, and subcornute. In cross section it is elliptical, somewhat curved in the plane of the shorter axis. The base or point of attachment is small, the corallum usually being free. The calice is deep and elliptical in outline and the columella can be seen only in very well preserved specimens. The wall is solid and covered with costae corresponding to all the septa, distinct to the base but more so in the vicinity of the calice where they alternate conspicuously in size. The costae are strongly granulated on their edges and sides. The septa are exsert, entire on their upper edges and sides laterally granulate. They are arranged in four complete cycles and six regular systems. Those of the first two cycles are nearly equal and more exsert than those of the remaining cycles. Septa of the higher sometimes fuse by their inner ends to those of the next lower cycle. The columella is thin and lamellar, not projecting much into the bottom of the calice, attaining a length of 3.2 mm. Near the bottom of the corallum it is attached to one of the septa lying in the long axis of the corallum. No dissepiments are present, but in most specimens there is a thick deposit of stereoplasma in the vicinity of the wall, particularly near the base, the costae often being obscured by it.

Dimensions.—

SPECIMEN	HEIGHT	CALICE
1. (Type)	15.5 mm.	10 x 14 mm.
2. (Plesiotype)	17.5	8.3 x 10
3. (")	11.5	9 x 13 x 4.5*
4. (")	?	10 x 12.5
5. (")	ca. 19	10 x 15.5

*Depth of calice.

Specimen 1 is Vaughan's holotype of *Parasmilia texana,* in the National Museum. Specimens 2, 3, and 4 are from the University of Texas collection. Specimen 5 is Vaughan's specimen of *Trochosmilia ? sp. indet.*

Type.—United States National Museum, Washington, D. C.

Plesiotypes.—University of Texas, Austin, Texas.

Occurrence: *Type locality.*—In the upper beds of the Buda limestone on Shoal Creek, Austin, Texas.

Other localities.—At Bouldin Creek, Austin, Texas; in the upper part of the lower beds of the Buda limestone on Brushy Creek at Round Rock, Williamson County, Texas.

Remarks.—The specimens from the University of Texas collection have been compared with the holotype of this species and are certainly identical with it in every respect. An examination of the holotype shows that there are no dissepiments, nor can any columella be seen because of the hard matrix with which the calice is filled. The details of the internal structure have been taken from plesiotypes. Vaughan's *Trochosmilia ? sp. indet.* is a part of a large specimen of this species which shows the thin, acute, alternating and granulated costae. As stereoplasma is deposited the costae become more rounded and lose their sharp edges.

This is the first species of this genus to be found in the Cretaceous. It apears to be related to the species now living in the Hawaiian Islands, *Placotrochus fuscus* Vaughan.[67] The fossil species which occur in the Tertiary of the West Indies are larger than the Cretaceous form from Texas.

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[67] Vaughan, T. W. Recent Madreporaria of the Hawaiian Islands and Laysan. U. S. Nat. Mus. Bull. 59, p. 66, pl. 4, figs. 2, 3, 1907.

Family TURBINOLIIDÆ Milne Edwards & Haime 1848 (pars)

Genus SMILOTROCHUS Milne Edwards & Haime 1851

Genotype.—*Trochosmilia ? tuberosa* E. & H. 1850. Cenomanian. Upper Greensand, Devonshire. (By monotypy).

Notes on the genus.—In 1899, Tomes[68] discussed the type species of this genus and concluded that it was a species of *Placosmilia* because he found a lamellar columella in a specimen from Blackdown which he identified with Duncan's *Placosmilia cuneiformis* (*non* E. & H.). He gives no other details of the interior of the corallum to support his conclusion, and the presence or absence of dissepiments remains undetermined. If his specimen is identical with *S. tuberosa* and lacks dissepiments, then the diagnosis of the genus must be changed to include the lamellar columella; but if dissepiments are present *Smilotrochus* becomes a synonym for *Placosmilia* and the species *S. austeni* E. & H. and *S. hagenowi* E. & H. should be re-studied to ascertain the propriety of a new genus. For the present I use *Smilotrochus* in the sense imparted to it by Milne Edwards and Haime.

Smilotrochus ? sp.

Description.—Corallum small, free, hemispherical or bowl-shaped. The calice is shallow, with a deep fossette. Septa in four complete cycles, thin, straight, granulate laterally. Those of the first two cycles are equal and extend to the edge of the fossette. The remaining 24 septa of the third and fourth cycles are short and extend less than half way. Exterior of the corallum unknown. Columella absent. No pali.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER
1.	3.2 mm.	6.0 mm.
2.	2.5	5.5
3.	3.0	6.0

Specimens.—United States National Museum.

Occurrence: In the Duck Creek beds of the basal Washita

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[68] Tomes, R. F. Observations on some British Cretaceous madreporaria, with descriptions of 2 new species. **Geol. Mag.** (IV), 6, pp. 303-304, 1899.

Division at the type locality of the Duck Creek, northeast of Denison, Grayson County, Texas. (Texas Christian University Collection).

Remarks.—Three specimens, partly pyritized and in the form of internal molds, are doubtfully referred to *Smilotrochus.* In form they are like *Trochocyathus wintoni* from the Pawpaw, but the absence of any columella and complete emptiness of the axial space distinguishes them. Better specimens, however, may change the generic reference.

Genus BLAGROVIA Duncan 1880

Genotype.—*B. simplex* Duncan 1880. Lower Eocene. Ranikot Series. Sind. (By monotypy).

Blagrovia palmerae n. sp. Plate 1, fig. 10; pl. 3, figs. 1, 2

Placosmilia sp. Adkins & Winton 1919. Univ. of Texas, Bull. 1945, p. 80, pl. 19, figs. 24-26.

Corals (sic) Winton 1925. Geol. of Denton Co., Univ. of Texas, Bull. 2544, pl. 3, figs. 11-13.

Description.—Corallum simple, attached by a very small base, or free in adult stages, cornute or conical in shape, slightly compressed. Calice deep, with an axial fossette open to the base. Septa in four complete cycles and part of the fifth, thin, lightly granulate laterally, entire on their upper edges, slightly exsert. Those of the first two cycles are equal, much larger than the rest and prominent in the calice. Septa of the third cycle small; fourth cycle developed between the first two and the third. Part of the septa of the fifth cycle are present between the fourth cycle and the first two cycles, very close to the latter, giving them a tri-lamellar appearance, as in *Dasmia.* The exterior of the corallum is marked by angular granulated costae corresponding to all the septa. Those belonging to the first two cycles are very prominent and give a marked compressed-dodecagonal shape to the calice. The other costae are much smaller, and those of the fifth cycle are sometimes so close to the principals as to be indistinguishable. Over the costae is laid a thin wrinkled epitheca which scarcely conceals them and extends to the margin of the calice, and in the smaller of the type specimens it is almost indistinguishable. There is no columella.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER OF CALICE
1. (Type)	10.0 mm.	6.5 x 9.5 mm.
2. (Paratype)	6.25	4.0 x 5.0

Types.—United States National Museum.

Paratypes.—Texas Christian University.

Occurrence: *Type locality.*—Pawpaw beds of the middle Washita on Sycamore Creek, Fort Worth, Tarrant County, Texas. (8 specimens, Texas Christian University collection). Five of these specimens are crushed nearly flat, owing to the lack of internal structures other than the thin septa.

Remarks.—*Blagrovia* differs from *Smilotrochus* only by the presence of a well-developed epitheca and is considered by most authors as a subgenus. The only other species known at present is the type, from the Eocene of India.[69] The present form is distinguished by its smaller size and peculiar arrangement of the septa of the first, second, and fifth cycles.

Genus CERATOTROCHUS Milne Edwards & Haime 1848 emend. Duncan 1884

Genotype.—*Turbinolia multiserialis* Michelotti 1838. Miocene. Tortone. (By subsequent designation, E. & H. 1850).

Ceratotrochus ? sp. Plate 1, fig. 14; pl. 3, figs. 12, 13

Description.—The corallum is simple and conical, not compressed, measuring 4 mm. in height and 4 mm. in diameter near the calice. The septa are straight, granuose or spinose on their sides, arranged in two groups. The first consists of nine principal septa, extending to, or nearly to, the columella. The second set comprises nine septa which are smaller and finer than those of the first and which extend less than half-way to the columella. There are no dissepiments. The columella is papillary, appearing in cross section as a group of rounded grains or columns. The costae are continuous with the septa through the wall of the corallum and are equal, rounded, with rounded granulations on their edges but none in the intercostal spaces, and distinct to the base. No epitheca.

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[69] Gregory, J. W. The fossil fauna of the Samana range and some neighboring areas. Part 7. The lower Eocene corals. **Pal. Indica**, new ser., vol. 15, pt. 7, p. 86, pl. 11, figs. 1-3, 1930.

Specimen.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—From the lower beds of the Buda limestone of Shoal Creek, Austin, Texas.

Remarks.—Only one specimen could be examined of this form, and that appears to represent a young individual, for it is still adherent at the base. The calice is unknown, and because of this and the apparent immature condition of the specimen, the species has not been named. Some of the columellar tubercles of this specimen look suspiciously like pali, and if they prove to be such, it is probably a *Trochocyathus* related to *T. sellardsi* and its variety *T. sellardsi graysonensis.*

Family CARYOPHYLLIIDÆ Dana (restr. Verrill)

Genus CARYOPHYLLIA Lamarck 1801

Genotype.—*Madrepora cyathus* Ellis & Solander 1786. Recent. Mediterranean.

Caryophyllia comanchei n. sp. Plate 1, fig. 15; pl. 3, figs. 26-28

Description.—The corallum is simple, of a size large for this genus, subconical, slightly curved, enlarging rapidly above the base, becoming subcylindrical toward the calice, with an elliptical cross section. The base is marked by a broad point of attachment. The calice, which is only partly shown, by one of the specimens, appears to be deep, with an elliptical outline and thick wall, inclined in the direction of the shorter axis. The septa are exsert, entire on their upper edges and granulated laterally. They are in four complete cycles and six regular systems, those of the first two cycles reaching the columella. The septa of the fourth cycle fuse by their inner edges to the sides of the third and are somewhat dentate. The pali, 12 in number, lie before the third cycle, as is typical of this genus. The costae, continuous with the septa, are very prominent, slightly alternating in size, very acute at their edges, profusely granulated on their sides and often more than 1 mm. in height. The columella is well-developed and is composed of twisted pieces. No epitheca or calcareous coating has been observed on the exterior.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS
1. (Type)	30 mm.	14 x 21 mm.
2. (Paratype)	27	17 x 27

The diameters are measured within the limits of the wall.

Type.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—The type and paratype are from the basal layers of the upper beds of the Buda limestone on Shoal Creek, Austin, Texas.

Remarks.—This species is unusually large for the genus, but the entire septa and the presence of pali before the third cycle make the reference quite certain. It is larger and more compressed than *C. cylindracea* (Reuss), a form common in the European Cenomanian, and differs from the three species described by Stoliczka[70] from the Ootatoor beds of southern India.

Genus PLATYCYATHUS de Fromentel 1863

Genotype.—*Trochocyathus terquemi* E. & H. 1857.

Turonian. Le Beausset. (Genolectotype, Wells 1933).

Notes on the genus.—There is some doubt as to the validity of this genuus, which differs from *Trochocyathus* only by having a discoid, rather than turbinate or conical, corallum. It bears the same relation to *Trochocyathus* as does *Cyclocyathus* to *Caryophyllia.*

De Fromentel in his original description[71] did not state whether *Trochocyathus terquemi* or *P. aptiensis* was the type of his genus. Because the former is the first figured and described, and because it is more characteristic of the genus as diagnosed by de Fromentel, it is here taken as the type.

Platycyathus scottianus n. sp. Plate 1, fig. 11; pl. 3, figs. 14-17

Description.—Corallum simple, free, discoid in shape, with a flat, or slightly convex or concave base. The septa are exsert, thin, equal, dentate on their upper margins and laterally granulate. In number they are 48, arranged in four complete cycles. Those of the first cycle are free and reach to the columella, terminating in pali. The septa of the second cycle are joined near the columella by the third cycle to which in turn the fourth cycle is fused. There are pali before the second cycle, making a total of twelve. The columella is fasciculate, small and not prominent. On the lower surface there are 48 rounded granulated costae, equal in size and usually distinct to the center of the base, although they tend to become obsolete. In some specimens there is a tendency for the costae corresponding to the first and second cycles to be slightly larger than the remainder, and occasionally there are rudimentary costae developed between the 48 principal ones.

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[70] Stoliczka, F. Cretaceous fossils of southern India. **Pal. Indica,** ser. 8, vol. 4, pt. 4, pp. 7-10, pl. 1, 1873.

[71] Fromentel, E. de. **Pal. franç. Terr. crét. Zoophytes,** p. 180, 1863.

Dimensions.—

SPECIMEN	DIAMETER	HEIGHT	
1. (Type)	4.5 mm.	1.5 mm.	
2. (Paratype)	4.5	1.3	
3. "	4.0	1.5	
4. "	3.75	1.75	
5. "	3.75	1.75	
6. "	3.5	1.3	(crushed)
7. "	3.7	1.5	"
8. "	3.5	2.0	"
9. (Ideotype)	4.5	1.75	
10. "	4.5	1.5	

Type.—United States National Museum.

Paratypes.—United States National Museum, Texas Christian University, Fort Worth, Texas.

Ideotypes.—United States National Museum, Texas Technological College, Lubbock, Texas.

Occurrence: *Type locality.*—The type and paratype come from the Weno beds of the middle Washita Division below the Katy Lake dam, Fort Worth, Texas.

Other localities.—Two specimens were in a collection from the Kiamichi, *Desmoceras* zone, sent to the United States National Museum for determination from North Double Lake, Tahoka, Lynn County, Texas, by M. A. Stainbrook.

Remarks.—This small species is easily distinguished by its discoidal form. It differs from *P. orbignyi* de Fromentel[72], from the Aptian of France, by its smaller size, equal costae, and fewer pali.

In the matrix of some specimens in the National Museum, from the Pawpaw beds, 1 mile north of Denison, Grayson County, Texas, are several external molds of what appear to be specimens of this species. Most of them are typical in shape, with a flat base, but one is bowl-shaped and may represent *Trochocyathus wintoni.*

Genus TROCHOCYATHUS Milne Edwards & Haime 1848

Genotype.—*Turbinolia mitrata* Goldfuss 1826. Miocene. Tortone. (By subsequent designation, E. & H. 1850).

Trochocyathus wintoni n. sp. Plate 3, figs. 5, 6

Description.—Corallum simple, low, free, bowl-shaped. Calice shallow, very little concave. Septa in four complete cycles, slightly exsert, thin, entire, laterally granular, with pali in two crowns before the first two cycles of septa, which are much larger than the rest. Septa of the third and fourth cycles apparently free on their inner ends. Columella small, fascicular, not prominent. Costae low, rounded, granular, becoming obsolete near the base, those corresponding to the first two cycles of septa very prominent near the calicular margin. The costae corresponding to the third cycle of septa are midway in size between the larger ones and the small ones of the last cycle.

Dimensions.—

SPECIMEN	HEIGHT	CALICE
1. (Type)	4 mm.	7 mm.
2. (Paratype)	3.5	5 x 5.5 (Distorted)

Type.—United States National Museum.

Paratypes.—Texas Christian University, Ft. Worth, Texas.

Occurrence: Type locality.—In the Pawpaw beds of the middle Washita on Sycamore Creek, Ft. Worth, Texas.

Remarks.—This species is distinguished by its bowl-shaped corallum with prominent costae corresponding to the 12 primary septa. In the case of *Platycyathus scottianus,* which occurs in the same beds, the corallum is discoid with nearly equal or slightly alternating costae. *T. harveyanus* E. & H. (Gault, England) has a variety[73] which approaches this species in shape, but from Duncan's figures there are two crowns of 12 pali each, whereas in the Pawpaw form the crowns contain but 6 pali each.

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[72] Fromentel, E. de. Pal. franç. Terr. crét., Zoophytes, p. 182, pl. 25, fig. 1, 1863.

Trochocyathus sellardsi n. sp. Plate 1, figs. 12, 13; pl. 3, figs. 3, 4

Description.—Corallum small, free, straight and conical, not expanding rapidly in size, sometimes slightly compressed. Calice circular, shallow. Septa exsert, relatively thick, granular laterally, straight, in three complete cycles. The first two cycles are equal, larger than the rest, extending to the columella where they terminate in pali. The pali are in two crowns, one before the first cycle, near the columella, the second before the second cycle and just outside the first. The columella is small, fascicular, deep in the calice. The costae correspond to all the septa, and are low, rounded and alternating in size, each one being marked by a single row of granulations. These granulations are alone visible on some specimens, and on some small specimens the costae are nearly equal.

Dimensions.—

SPECIMEN	HEIGHT	CALICE
1. (Type)	3 mm.	2.5 mm.
2. (Paratype)	3.2	2.5
3. (")	4	2 x 3 (crushed)
4. (")	4	3
5. (")	3	2 x 3 (")

Type.—United States National Museum.

Paratypes.—Texas Christian University, Ft. Worth, Texas.

Occurrence: *Type locality.*—In the Pawpaw beds of the middle Washita Division, on Sycamore Creek, Ft. Worth, Texas. (Texas Christian University collection).

Remarks.—This species is distinguished by its conical corallum with only three cycles of septa. *T. wintoni* possess 4 complete cycles and is hemispherical in form. *T. conulus* (Michelin) of the Gault (Albian) of Europe is conical and small but possesses

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[73] Duncan, P. M. Supplement to the British Fossil Corals. **Pal. Soc. London,** pp. 32-33, pl. 12, figs. 1-4, 13; pl. 14, figs. 1-2, 1870.

4 cycles of septa. *T. gracilis* E. & H.[74] from the Cenomanian of France, is a small species with 12 pali, but is more compressed and the corallum somewhat curved, and has 4 cycles of septa. De Fromentel[75] revised the original description and showed that there were only 12 pali.

Trochocyathus sellardsi var. **graysonensis**, n. var. Plate 3, figs. 7, 8

Type.—United States National Museum.

Paratypes.—Texas Christian University, Ft. Worth, Texas.

Occurrence: *Type locality.*—In the Grayson marl at Grayson Bluff, Grayson County, Texas. (Texas Christian University Collection).

Remarks.—This variety is distinguished from *T. sellardsi* mainly by its greater size. It is proportionally taller. Seven pyritized internal molds have the following dimensions:

SPECIMEN	HEIGHT	DIAMETER
1.	6 mm.	3.5 mm.
2.	5.75	3.7
3.	5.7	3.0
4.	5.0	3.0
5.	4.5	3.0
6.	4.1	3.0
7.	4.0	3.0
	5.0 mm.	3.1 mm. Average

The original specimens of these molds must have been much larger. The number of septa is the same, 24, in three cycles with two crowns of pali.

Family TROCHOSMILIIDÆ Pourtalès

Genus TROCHOSMILIA Milne Edwards & Haime 1848

Genotype.—*Turbinolia corniculum* Michelin 1848.

Eocene, France. (Genolectotype, Gregory, 1900).

Note on the genotype.—In 1850 Milne Edwards and Haime[76] designated their species *Trochosmilia faujasi* of the Maestrichtian as the type of the genus, but Gregory[77] pointed out that this was not mentioned by the authors[78] of the genus in their original diagnosis and selected *T. corniculum,* which is the first species mentioned as an example, as the genolectotype.

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[74] Milne Edwards, H. and Haime, J. Monographie des Turbinolides. **Ann. Sci. Nat.**, vol. 9, pp. 305-306, pl. 10, fig. 5, 1848.

[75] Fromentel, E. de. **Pal. franç. Terr. crét., Zoophytes**, p. 174-175, pl. 6, fig. 2, 1863.

[76] Milne Edwards, H. & Haime, J. British Fossil Corals, **Pal. Soc.**, p. xxiv, 1850.

Trochosmilia stainbrooki n. sp. Plate 4, figs. 1-8

Description.—Corallum simple, free, in adult stages, cornute in shape, with an elliptical, nearly level, shallow calice. The septa vary in number from about 100 in the smallest specimen to 116 and 133 in the larger ones, of which about half reach to the center of the corallum and may unite. They are nearly equal in size, rather thin, crowded in the calice, laterally granular and with the upper margins entire. The calicular margin is broad and rounded and the edges of septa slope gently downward towards the center of the corallum. The exterior of the corallum is marked by equal, rounded, beaded costae corresponding to all the septa. In the smaller specimen there is a tendency for the costae to alternate in size. There is no columella. Dissepiments are rare. The costae do not all descend regularly to the base of the corallum. Those on the convex side of the corallum, covering about one quarter of the circumference, extend to the base, whereas the remaining costae, covering the concave side and about three quarters of the circumference, extend downwards perpendicularly from the plane of the calice and meet the first group of costae at an angle varying from 0° near the calicular margin to 90° near the base. This feature is present on all nearly all specimens, but does not seem to be of more than specific importance.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS OF CALICE	NO. OF SEPTA
1. (Type)	30 mm.	18 x 24 mm.	116
2. (Paratype)	29	18 x 25	133
3. (")	22	16 x 18	100

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[77] Gregory, J. W. Jurassic Fauna of Cutch. The Corals. **Pal. Indica.**, ser. 2, vol. 9, pt. 2, 1900.

[78] Milne Edwards, H. & Haime, J. Notes sur la classification de la deuxième tribu de la famille des Astreides. **Comptes Rendus Acad. Sci., Paris**, vol. 27, p. 467, 1848.

Type.—United States National Museum.

Paratypes.—Texas Technological College, Lubbock, Texas.

Occurrence: *Type locality.*—Zone of *Gryphaea tucumcari* in the Kiamichi at Three Lakes, Bailey County, Texas. (Collected by M. A. Stainbrook).

Other localities.—(a) Kiamichi at Bull Lake, Lamb County, Texas. (Collected by M. A. Stainbrook). (b) Kiamichi, "Limy Layer", Guthrie Lake, Tahoka, Lynn County, Texas. (Collected by M. A. Stainbrook).

Remarks.—De Angelis d'Ossat, in his work on the Urgonian corals of Catalogna[79], divides the species of *Trochosmilia* into three groups: (1) *T. inflexa,* (2) *T. complanata,* (3) *T. didyma.* The present species belongs in the first group, characterized by trochiform or compressed corallum, circular or oval calice, and straight or recurved corallum. Its distinguishing features are the large number of septa and the costal arrangement. Twenty-four specimens were examined. They show considerable variation in size, but the form of the corallum is constant. The peculiar arrangement of the costae is usually found but is often obscure. *T. sulcata* E. & H.[80], from the Gault at Folkestone, England, is the only other Albian species of *Trochosmilia* now known. It belongs to de Angelis d'Ossat's second group, characterized by the strongly compressed cuneiform coralla with elongated elliptical calices.

Genus COELOSMILIA Milne Edwards & Haime 1850

Genotype.—*Parasmilia poculum* E. & H. 1848.

Recent. ??. (By monotypy).

Note on the genotype.—Although this species was designated at the type species by the authors of the genus (Brit. Foss. Cor., p. xxv), it has not been noticed or collected since and its habitat is unknown. *Coelosomilia laxa* E. & H. (Senonian, Upper Chalk, England) is generally taken by most authors as the type.

Coelosmilia texana (Conrad) Plate 4, figs. 17-22

Turbinolia texana Conrad 1857. Mex. Boundary Survey, vol. 2, pt. 2, p. 144, pl. 2, figs. 3a-b.

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[79] de Angelis d'Ossat, G. Coralli del cretacico inferiore della Catalogna. **Palaeontographica Italica**, vol. 11, p. 221, 1905.

[80] Milne Edwards, H. & Haime, J. British Fossil Corals. **Pal. Soc. London,** p. 68, pl. 11, fig. 8, 1850.

Coelosmilia texana Böse 1910. Inst. Geol. Mex., Bol. 25, pp. 51, 53, pl. 45, figs. 9, 14, 15, 18, 20, 22.

Coelosmilia chihuahuensis Böse 1910. Ibid., pp. 51, 53, pl. 45, figs. 6, 8, 13, 16, 17, 23-25. (Not described).

Trochosmilia texana Felix 1914. Fossilium Catalogus, pars 5, p. 83.

Parasmilia austinensis Winton & Adkins 1919. Univ. of Texas, Bull. 1931, p. 33.

Trochosmilia texana Winton & Adkins 1919. Ibid, p. 33.

Parasmilia austinensis Adkins & Winton 1919. Univ. of Texas, Bull. 1945, pp. 17, 79, pl. 19, figs. 27-30.

Trochosmilia texana Adkins & Winton 1919. Ibid, pp. 79-80.

Parasmilia texana Winton 1925. Univ. of Texas, Bull. 2544, p. 51, pl. 12, figs. 3-5.

Trochosmilia chihuahuensis Adkins 1928. Univ. of Texas, Bull. 2838, p. 76.

non *Parasmilia austinensis* Roemer 1888. Pal. Abh. p. 6, pl. 1, fig. 1.

Description.—Corallum simple, free, cornute. Calice deep, elliptical in outline, the shorter axis inclined in the direction of curvature. Height of corallum: 28 mm., diameters of calice: 11 x 17 mm. Septa in 4 complete cycles, thin, granulate, those of the first two cycles being equal and thicker than the rest, extending almost to the center of the corallum. They are entire on their upper edges and fall quickly to the bottom of the calice. No columella. On the exterior there are 48 nearly equal costae, with acute margins, separated by interspaces broader than the costae which are filled with small granules, the costae having a cristate appearance. The costae are distinct to the base. Near the base the costae of the first two cycles are larger than those of the higher cycles. No epitheca.

Dimensions.—

	SPECIMEN	HEIGHT	DIAMETERS
1.	(Holotype)	28 mm.	11 x 17 mm.
2.	(Paratype)	22+	11 x 13
3.	(Homeotype)	13	12.5 x 16.5
4.	"	19	12 x 14
5.	"	29	18 x 22
6.	"	22	17 x 20
7.	"	21	15 x 18
8.	"	22	15.5 x 17.5
9.	"	11	10 x 11.5
10.	"	25 ?	14 x 15.5
11.	"	12+	6 x 9

12.	"	13+	11 x 14
13.	"	12+	9 x 11.5
14.	"	18	10 x 15

Type and Paratype.—U. S. N. M. No. 9836.

Homeotypes.—United States National Museum, University of Texas, Texas Christian University, Texas Technological College.

Occurrence: *Type locality.*—Leon Springs, between El Paso and Frontera, Texas, according to the label on the specimens.

Other localities.—In the Walnut formation (lower Fredericksburg) at the following localities: (a) In a gravel pit on the road up Bull Creek, northwest of Austin, Travis County, (University of Texas Collection). (b) "7 miles west of Austin", Travis County. (United States National Museum). (c) Devil's Courthouse Mt., six miles north of San Angelo, Tom Green County, Texas. (University of Texas Collection).

In the upper Goodland formation (middle Fredericksburg) at the following localities: (a) West of the Texas Pacific Railroad shops on the road to Benbrook, Ft. Worth, Tarrant County, Texas. (United States National Museum). (Collected by J. Patton, 1930). (b) Cragin's Knobs, Ft. Worth, Tarrant County, Texas. (Texas Christian University). (c) In Denton County, Texas. (Winton, 1925). (d) 15.5 miles southwest of Gainsville on the road to Decatur, Wise County, Texas. (U. S. G. S. Mes. Loc. 1507). A slab with 3 specimens.

In the Kiamichi beds (upper Fredericksburg) at the following localities: (a) "Limy layer" at Guthrie Lake, Tahoka, Lynn County, Texas. (Collected by M. A. Stainbrook). (b) Zone of *C. tucumcari* at Three Lakes, Bailey County, Texas. (Collected by M. A. Stainbrook). (c) Zone of *C. tucumcari,* Bull Lake, Lamb County, Texas. (Collected by M. A. Stainbrook).

In the Edwards limestone, (upper Fredericksburg) at the following locality: (a) One quarter mile east of south end of Quitman Mountains, Eagle Mountain Quadrangle, West Texas. (U. S. G. S. Mes. Loc. 1903).

Horizon uncertain, (Fredericksburg division), at the following localities: (a) 4 miles west of El Paso, Texas, on the Rio Grande Railroad. (U. S. G. S. Mes. Loc. 1689). (b) 2 miles south of Decatur, Wise County, Texas. (U. S. N. M. Loc. 445a). (c) 2 miles below A. L. Ranch, Rio Grande River. (U. S. G. S. Mes. Loc. 1891). (d) Uppes Fredericksburg, Rio Grande River near initial monument, U. S.-Mexican boundary, above El Paso, Texas. (U. S. N. M. No. 1942). (e) Number 1 of section 4 miles above El Paso, Rio Grande River (Walnut?). (U. S. N. M. 1462).

Böse, in the paper cited in the synonymy, reports *C. texanus* and *C. chihuahuensis* from the equivalent of the Comanche Peak formation (subdivision 2) at La Encantada, cerca del Placer de Guadaloupe, Chihuahua, Mexico.

Remarks.—The preceding description is that of Conrad's type specimen in the National Museum. With the type is another specimen from the same locality which shows a little of the interior of the corallum, lacks a columella and is nearly void of dissepiments. It is more attenuate than the type and lacks the basal portion, but is otherwise similar. The description holds true for the other specimens noted above, except for variations in the shape of the corallum. In some specimens there is a tendency for the septa of the higher cycles to unite to those of the lower. The costæ are subject to some variation, being entire with no granulations in some cases and coarsely granulated in others. Sixty-nine specimens which are referable to this species from the Fredericksburg division, have been examined by the author. They show considerable variety in size and form, but all are essentially the same and the variation is not constant in any locality. The number of septa is always 48 in mature specimens and the calice is always elliptical, but the corallum may vary in shape from cornute with an inclined calice to a straight cone with a level calice, although the cornutiform corallum in commonest. The granulated interspaces and costal granulations are usually not shown on the specimens, except on mature ones.

Böse has, in the paper cited above, figured *C. texana* together with *C. chihuahuensis,* a new species, but there is no description of the latter, and from his figures it is probably the same as *C. texana,* and occurs with it in the same beds.

One specimen in the United States National Museum which may represent a variety of this species, comes from beds with *Alectryonia quadriplicata* (middle Washita) at a point 4 miles west of El Paso, Texas.

Winton, in the paper cited in the synonymy (1925), notes that this species is a reliable horizon marker for the upper Goodland in Denton County, Texas.

The range of this species as it is now known is throughout the Fredericksburg division.

Coelosmilia americana Roemer Plate 4, figs. 15, 16

Coelosmilia americana Roemer 1888. Pal. Abh., vol. 4, pt. 4, pp. 6-7, pl. 1, figs. 5a, 5b.
Coelosmilia americana Felix 1914. Fossilium Catalogus, pars 5, p. 64.
Coelosmilia americana Adkins 1928. Univ. of Texas, Bull. 2838, p. 77.

Type.—University of Breslau, Breslau. (f. Adkins, 1928).

Occurrence: *Type locality.*— In the Edwards limestone on Barton Creek, Austin, Texas.

Remarks.—Although this is apparently a well-marked species, no specimens have been seen. It differs from *C. texana* by having only three cycles of septa (Roemer, in his figure shows only 18), and is attached by a large base. Roemer's figures of the species are shown on Plate 4, figs. 15, 16.

Genus PARASMILIA Milne Edwards & Haime 1848 (pars)

Genotype.— *Madrepora centralis* Mantell 1822. Senonian, Upper Chalk England. (By subsequent designation, E. & H., 1850).

Parasmilia austinensis Roemer Plate 4, figs. 9-11

Parasmilia austinensis Roemer 1888. Pal. Abh., p. 6, pl. 1, figs. 1a-1b.
Parasmilia austinensis Grabau & Shimer 1909. North American Index Fossils, vol. 1, p. 99
Parasmilia austinensis Felix 1914. Fossilium Catalogus, pars 5, p. 67.
non *Parasmilia austinensis* Winton & Adkins 1919. Univ. of Texas, Bull. 1931, p. 33.
non *Parasmilia austinensis* Adkins & Winton 1919. Univ. of Texas, Bull. 1945, p. 79, pl. 19, figs. 27-30.
non *Parasmilia austinensis* Winton 1925. Univ. of Texas, Bull. 2544, p. 51, pl. 12, figs. 3-5.
Parasmilia austinensis Adkins 1928. Univ. of Texas, Bull. 2838, p. 77.

Description.—Corallum simple, usually attached by a small base, cylindrical, conical, or cornute in shape. The calice is shallow and elliptical in outline; in mature specimens it is slightly smaller than the greatest diameter of the corallum. The septa number 48, in four complete cycles. Near the wall they are all equal, but only the alternate ones extend to meet the columella. Their upper edges are entire, their sides strongly granulated. The columella is spongy and small, not prominent in the calice. The exterior of the corallum is covered by costae corresponding to the septa, equal in size, with acute edges and grooved interspaces covered with fine granulations. The corallum of cylindrical individuals is marked by occasional low swellings and constrictions. Dissepiments sparse.

Dimensions.—Five Typical Specimens (Topotypes).

SPECIMEN	HEIGHT	CALICE	CORALLUM
1.	25 mm.	7.5 x 9 mm.	Cylindrical, curved
2.	20	6.5 x 9	Cylindro - conical
3.	18	6.0 x 6.5	Cylindro - conical curved
4.	12.5	4 x 5.5	Cornute
5.	10.5	7 x 7.5	Cornute
6*.	27	14 x 17	Cylindro - conical

*Roemer's figured Specimen

Type.—University of Breslau, Breslau. (f. Adkins 1928).

Tophomeotypes.— United States National Museum.

Occurrence. In the Edwards limestone in the vicinity of Austin, Texas, at the following localities: *Type locality.*—Barton Creek, 1 mile from mouth. *Other locality.*—Deep Eddy Bluff, Colorado River.

In limestone one quarter mile east of the south end of the Quitman Mountains, Eagle Mt. Quadrangle, Texas. (U. S. G. S. Mes. Loc. 1903).

One doubtful specimen comes from the Edwards limestone, Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas. (United States National Museum). (Collected by J. Patton, 1930).

Two specimens probably belonging to this species are from the Goodland beds 15.5 miles southwest of Gainsville, Cooke County, on the road to Decatur, Wise County, Texas, occurring with *Coelosmilia texana* (Conrad). (U. S. G. S. Mes. Loc. 1507).

Remarks.— This species is not very common in the Edwards limestone at the type locality on Barton Creek. It is distinguished by its four cycles of septa, spongy columella, and regular, equal costae. It is always larger than *P. graysonensis,* is usually curved and possesses more acute costae.

In the synonymy it is indicated that several specimens have been incorrectly identified with this species. *P. austinensis* Adkins and Winton, 1919, is referred in this paper to *Coelosmilia texana* (Conr.), as is also *P. austinensis* Winton, 1925.

Parasmilia graysonensis n. sp. Plate 4, fig. 12

Description.—Corallum small, conical, slightly curved and attached by a small base. Calice fairly deep with a sharp margin, nearly circular in outline. Septa in four complete cycles, of which the first two are equal and extend to the columella. They are thin, crowded, and non-exsert, their upper margins entire and rapidly descending to the bottom of the calice. Columella small, not prominent, spongy. The costae, corresponding to all the septa are rounded and broad, heavily beaded, regularly alternating in size. Dissepiments very sparingly developed.

Dimensions.—

Specimen		Height	Diameter of Calice
1.	(Type)	7.0 mm.	7.0 x 7.0 mm.
2.	(Paratype)	7.5	6.5 x 6.5
3.	"	5.5	5.0 x 5.5
4.	"	6.5	4.0 x 4.0
5.	"	5.0	4.0 x 4.5

Type.—United States National Museum.

Paratypes.—Texas Christian University.

Occurrence: *Type locality.*— Grayson marl, (upper Washita), at Grayson Bluff, Grayson County, Texas. (Texas Christian University Collection). (Pyritized specimens).

Remarks.—This species is distinguished from *P. austinensis* by its small size and rounded beaded costae. It differs from *P. ? sp.* of the Comanche Peak by its smaller number of septa and relatively smaller calices in proportion to its height.

Two other Cenomanian species are *P. pusilla* Pôcta[81] from Bohemia, and *P. guillieri* de Fromental[82]. The former has from

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[81] Pôcta, P. Anthozoen der Böhmischen Kreideformation, p. 44, text figs. 21, 22, 1887.

[82] Fromentel, E. de. **Pal. franç., Terr. crét., Zoophytes.** p. 213, pl. 23, fig. 1, 1862.

34 to 36 septa and a relatively larger columella, while the latter is a much larger form with a broad base with a nearly cylindrical corallum.

Parasmilia ? sp. Plate 4, figs. 13, 14.

Dimensions.—

HEIGHT	DIAMETERS
16 mm.	16.5 x 17.5 mm.

Specimen.— Adkins Collection, Bureau of Economic Geology, Austin, Texas.

Occurrence: In the Comanche Peak formation on Power's place, Valley Mills, Bosque County, Texas. (Collected by W. S. Adkins).

Remarks.—A single, badly-preserved, pyritized specimen is here doubtfully referred to this genus. It is conical in shape, expanding rapidly from a small base, with a nearly circular, shallow, calice. The septa number approximately 75, of which about half reach the columella. The columella is spongy and well-developed. The costae correspond to all septa, and are equal in size, rounded, with beaded edges. All finer structure has been destroyed and the character of the septal margins and ends cannot be determined, nor can the presence of dissepiments be ascertained. It is possible that dissepiments are absent and that pali are present, in which case this would be nearer *Trochocyathus* or *Caryophyllia*. It is much larger than *P. graysonensis* and more broadly conical than *P. austinensis*.

Genus PLEUROSMILIA de Fromentel 1856

Genotype.— *Pleurosmilia grandis* de Fromentel. Portlandian. Mantoche, France. (Genolectotype, Wells, 1933).

Notes on the genus.—This genus was founded for a series of upper Jurassic corals. In the original description de Fromentel[83] listed and described nine new species of the genus, but neglected to designate a type species, nor have I been able to find that a type has ever been designated. I therefore choose *P. grandis* de Fromentel 1856, the second of his species, as the genolectotype. This species is chosen rather than the first, *P. graciosa*, because it corresponds more closely to the generic diagnosis than does the latter.

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[83] Fromentel, E. de. Note sur les Polypiers fossiles de l'étage Portlandien de la Haute-Sâone. **Bull. Soc. Géol. France**, (2), 13, p. 853, 1856.

Gregory[84] held that this genus was synonymous with *Placosmilia* E. & H. 1848 on the grounds that the presence or absence of an epitheca is not a generic character. In *Placosmilia* the epitheca is absent or rudimentary, and the costae always well-developed, thick or thin, and completely covers the costae.

Synopsis of the Texas species of Pleurosmilia.—

1. Four complete cycles of septa (48):
    - A. Calices rarely larger than 18 x 24 mm. .... *P. saxifisi* n. sp. (Buda).
    - B. Calices about 32 x 40 mm. .... *P. sp.* (Glen Rose).
2. Five complete cycles of septa (96):
    - A. Septa thick; columella stout:
        1. Septa varying between 85 and 100, alternating, corallum conical to cylindrical. .... *P. craginiana* n. sp. (Fredericksburg).
        2. Septa regularly 96, corallum cylindrical, irregularly constricted. .... *P. quaylei* n. sp. (Buda).
        3. Septa thin, columella thin. .... *P. Whitneyi* n. sp. (Buda).

Pleurosmilia craginiana n. sp. Plate 4, figs. 23-24

Description.—Corallum simple, usually fairly large, conical in the younger stages to cylindro-conical and curved in more mature specimens. Some small specimens are broad and short, expanding rapidly from the base. Calice elliptical or nearly circular, with rounded margins and a deep, empty, fossette. The septa are entire (?), strong and thick, numerous, and number from 85 to 100, regularly alternating in size, the larger and thicker ones twice as long as the rest and extending about three quarters of the distance to the axis of the fossette. They are united by an abundant and highly developed endotheca. The columella is a thick lamella, parallel to the longer axis of the corallum, and attached to one large septum. A complete epitheca covers the exterior, strongly wrinkled by lines of growth. In some specimens the epitheca, however, may be completely removed by weathering.

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[84] Gregory, J. W. Jurassic Fauna of Cutch, Corals. **Pal. Indica,** ser. 2, vol. 9 pt. 2, pp. 74-75, 1900.

Dimensions.—

	Specimen	Height	Calicular Diameters
1.	(Type)	45 mm.	32 x 40 mm.
2.	(Paratype)	53	22 x 31
3.	”	18	28 x 32
4.	”	83	25(?) x 30(?)
5.	”	39	31 x 38

Type.—United States National Museum.

Paratypes.—United States National Museum, Texas Christian University, Texas Technological College.

Occurrence: *Type locality.*— Specimen 1 is from the Goodland beds at Benbrook County, Texas. (Texas Christian University Collection).

Other localities.—Specimens 2 and 3 are from the Goodland beds at Cragin's Knobs, five miles west of Ft. Worth, Texas. (Texas Christian University Collection).

Specimen 4 and two other specimens are from the Goodland outlier eight miles southeast of Weatherford, Parker County, Texas. (Texas Christian University collection).

One specimen comes from the Comanche Peak formation three miles northwest of Jarrell, Williamson County, Texas. (United States National Museum).

Two specimens from the Edwards limestone are from Bluff Creek, five miles west of Crawford, McLennan County, Texas. (United States National Museum Locality No. 3270).

Specimen 5 is from a locality in Coryell County, Texas. (Collected by M. A. Powell, in M. A. Stainbrook's collection).

Remarks.—It will be seen from the dimensions given above that this is a variable species. Corals of this kind are very sensitive, so far as their shape is concerned, to the conditions of their environment.

The nearest relation to this form may be a species which I have noted[85] as *Peplosmilia ? sp.* from the lower Glen Rose formation in Hays County, Texas. In that form the columella does not appear to be united to a larger septum, but the poor condition of the only specimen found makes this uncertain, although it is probably a *Pleurosmilia.*

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[85] Wells, J. W. Corals of the Trinity Division of the Comanchean of central Texas. **Jour. Paleont.**, vol. 6, no. 3, p. 233, pl. 30, fig. 1, 1932.

This species occurs in formations somewhat younger than those from which this genus has been reported heretofore, except the species from the Buda limestone which do not seem to be closely related to the present form.

Pleurosmilia whitneyi n. sp. Plate 2, fig. 20; pl. 5, fig. 5

Description.— The corallum is simple, large, straight cylindrical above the base, and slightly compressed. The calice is not preserved but is probably shallow and oval in outline. The septa are shown well in a transverse section and form five complete cycles (96 septa). They are thin and wavy; those of the first two cycles are equal and extend nearly to the columella. The septa of the remaining cycles are not much smaller but are considerably shorter, according to the cycle. The dissepiments are well-developed and form an outer zone limited by the inner ends of the fourth cycle of septa. The columella is thin and lamellar, measuring 4.5 mm. in length, parallel to the longer axis of the corallum. The epitheca is not preserved on the holotype but was probably thin.

SPECIMEN	HEIGHT	DIAMETERS
(Holotype)	52 mm.	41 x 47 mm.

Holotype. — Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the lower beds of the Buda limestone in the first creek south of Manchaca, Travis County, Texas. (University of Texas Collection).

Remarks.—This species is distinguished by its relatively large size, thin septa, and thin columella. It is much larger than other species of this genus described in this paper.

Pleurosmilia saxi-fisi n. sp. Plate 2, fig. 17; pl. 5, figs. 1-2

Description.— The corallum is of medium size, subcylindrical, straight or slightly curved. The exterior surface is made very irregular by strong transverse ridges. The base is usually broad and attached. The margin of the calice is reflexed so that the septa are projecting. The type specimen measures 20 mm. in height, and has a maximum diameter at the upper limit of the epitheca of 19 mm. and a smaller diameter of 16.5 mm. Another specimen, larger than the type, possesses diameters of 24 and 18 mm., respectively. The calice is shallow, about 3 mm. in depth, the cavity being elliptical in outline. The septa are unequal, 48 in number, arranged in four cycles and six regular systems. The columellar septum is not larger than the rest and thins slightly at its junction with the columella proper. The septa of the first and second cycles are equal and thick, not quite reaching the columella. The septa of the third cycle are thin and about two thirds the length of the principal septa, and those of the fourth are short and thin. The columella is thin, lamellar, parallel to the longer axis of the corallum, attached to one septum. In the type it measures 3 mm. in length; in the other specimens mentioned above it is 4.5 mm. The dissepiments are well-developed, confined to an outer zone limited internally by the inner ends of the tertiary septa, and regularly spaced about 1.2 mm. apart. The epitheca is stout and marked by wrinkled lines of growth.

Type.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the lower beds of the Buda limestone on Brushy Creek, Round Rock, Williamson County, Texas.

Other localities.—In the lower and upper beds of the Buda limestone at "The Oaks" on Shoal Creek, Split Rock on Shoal Creek, and 31st Street, at Shoal Creek, Austin, Texas.

Remarks.—This species is marked by the short corallum and by the irregular transverse ridges. The number of septa in all the specimens examined is constant, 48.

This is a much smaller species than *P. craginiana* and has fewer septa. Its shape is much like that of *P. quaylei* but it has one less cycle of septa and is always smaller.

Pleurosmilia quaylei n. sp. Plate 2, fig. 16; pl. 5, figs. 3-4

Description.—The corallum is simple, of medium size, cylindrical, almost circular in outline. It is marked by frequent contractions and expansions due to intermittant fluctuations in growth. The calice is not preserved, but apparently was shallow, almost superficial, with reflexed margins. The septa form five complete cycles as in *P. whitneyi.* Those of the first two cycles, 12 in number, are strong and nearly reach the columella. The third cycle is about two thirds as long. The septa of the remaining cycles are much finer. The dissepiments are well-developed and form a zone bounded by the inner ends of the fourth cycle of septa. The columella is lamellar and much stouter than that of *P. whitneyi,* reaching a length of 6 mm. The epitheca is strong but frequently interrupted by the fluctuations of growth of the corallum. It is marked by concentric lines of growth.

Dimensions.—

Specimen	Height	Diameters
(Holotype)	34 mm.	28 x 30 mm.

Holotype. — Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the lower beds of the Buda limestone in the first creek south of Manchaca, Travis County, Texas.

Other localities.—One specimen, which may be of this species, comes from the upper part of the lower beds of the Buda limestone at "The Oaks", Shoal Creek, Austin, Texas.

Remarks.— This species differs from *P. whitneyi* principally in the circular outline of the corallum, and also in the character of the septa and columella. It is, in general, much smaller than that species.

Genus PLACOSMILIA Milne Edwards & Haime 1848

Genotype.— *Turbinolia cymbula* Michelin 1846. Turonian. Soulage (Corbières). (By subsequent designation, E. & H. 1850).

Placosmilia bravoensis (Aguilera) Böse

Placosmilia bravoensis (Aguilera) Böse 1910. Bol. Inst. Geol. 25, pp. 26, 33, pl. 45, fig. 11.

Placosmilia bravoensis Felix 1914. Fossilium Catalogue, pars 5. p. 129.

Placosmilia mexicana (Aguilera) Böse

Placosmilia mexicana (Aguilera) Böse 1910. Bol. Inst. Geol. 25, pp. 26, 33, pl. 45, figs. 10, 19, 21.

Placosmilia mexicana Felix 1914. Fossilium Catalogus, pars 6, p. 130.

Types.—Instituto Geologico de Mexico, Mexico City.

Occurrence: *Type locality.*— Both species are said by Böse to occur in the lower Cenomanian (Sub-division 6 - Middle Washita) at Cerro de Muleros, Chihuahua, Mexico.

Remarks.—No specimens of these species have been seen by the author and they are not yet known from formations in Texas. Although Böse figured these species, he did not describe them, and it is doubtful if specimens could be identified with his figures if they were found.

Genus **BUDAIA** n. gen.

Genotype.—*Budaia travisensis,* n. sp. Buda limestone. Central Texas.

Diagnosis of genus.—The corallum is simple, conical, straight, curved or distorted. The wall consists of the outer ends of the septa joined by a well-developed epitheca. The calice is circular and of moderate depth. The septa are non-exsert, few in number, irregularly arranged, well-developed, not extending beyond the wall, solid, with few lateral granulations and entire on their upper edges. Endothecal dissepiments are abundant, forming two main zones separated by an intermediate one. The outer is composed of vertically inclined vesicular tissue and is confined to a narrow area just within the wall. The inner zone consists of inwardly arched vertical plates between the septa and lies at their inner ends. The intermediate zone is like the inner one but is not so compact. Transverse dissepiments resembling tabulae occur frequently between the septa in the two inner zones but rarely extend entirely across the cavity. There is no columella. The epitheca is complete and thin, not marked by costae.

Remarks.—This genus is most closely related to *Aulastraeopora* Prever[86], a genus assumed by its author to be an evolved form of the upper Jurassic genus *Aulastraea* Ogilvie, which occurs in the Cenomanian of the Monti d'Ocre region in Italy. Prever describes nine new species of his genus, but fails to designate a type species. *A. deangelisi* Prever[87] is here taken as the type of the genus. The wall and septal arrangement are the same in both genera, but the endotheca is decidedly different. In *Aulastraeopora* there are two well-marked zones, an outer one between the septa, and an inner one filling the axial space. In *Budaia* there are three, outer, intermediate, and inner. *Budaia*, as far as is known, is exclusively a simple form, whereas *Aulastraeopora* includes both simple and colonial forms.

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[86] Prever, L. Anthozoa della fauna Cenomaniana dei Calcari i Scolliera. **Mem. alla descr. della carta d' Italia del Com. geol. del regno.** Vol. 5, pt. 1, Roma, 1909.

[87] **Ibid.** p. 138, text figs. 32-37.

Budaia travisensis n. sp. Plate 2, figs. 1-5; pl. 5, figs. 6-8

Description.—The corallum is simple, of medium size, subconical, straight, curved or distorted. The calice is not well-preserved in any of the specimens, but is probably circular and moderately deep. The wall is well-developed and continuous with the outer ends of the septa. The septa are laminar, non-exsert, entire on their upper edges, granular laterally, not reaching to the center of the corallum, more or less radially arranged, and stout. The cyclical arrangement is irregular. In the type specimen there are 8 larger septa extending nearly to the center (near the calice) and 8 smaller septa about one-third the length of the former. The endothecal dissepiments are abundant and lie in two main zones. The first, an outer zone, is peripheral and is composed of vesicles vertically inclined. The second zone lies near the inner ends of the septa and is composed of vertical plates. Between these two points of concentration are scattered dissepiments. Irregular tabulae-like dissepiments appear in longitudinal sections. There is no columella. The epitheca is thick and non-costulate, marked by grooves opposite the septal ends and fine longitudinal ridges crossed by concentric lines of growth.

Dimensions.—

	SPECIMEN	HEIGHT	DIAMETER
1.	(Type)	32 mm.	12 mm.
2.	(Paratype)	58	18
3.	"	25	8
4.	"	20	8

Type and paratypes.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: Type locality.— Basal Buda limestone on Shoal Creek, Austin, Texas.

Other localities.— Lower and upper beds of the Buda limestone along Shoal Creek, Austin, Texas; in the creeks near Manchaca, Travis County; and on Brushy Creek, Round Rock, Williamson County, Texas.

Family EUSMILIIDAE Verrill

Genus DENDROGYRA Ehrenberg 1834

Genotype.— *Dendrogyra cylindrus* Ehrenberg 1834. Recent. West Indies. (By subsequent designation, E. & H. 1850).

Dendrogyra ? dumblei n. sp. Plate 5, fig. 10

Description.— Corallum massive, irregular, small. The holotype measures 35 x 43 x 13 mm. Valleys short and circumscribed or as much as 40 mm. in length, shallow. Average width within walls 1.5 mm. Distance between centers of adjoining series 2 to 2.5 mm. Walls of valleys fused and thick, averaging 0.8 mm. Septa relatively few, short, thick, apparently all equal and reaching to the columella. In a distance of 5 mm. there are 10 to 12 septa in the longer, straighter valleys. Calicular centers indistinct. Columella lamellar, solid, continuous, well-developed.

Holotype.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the Edwards limestone at Speck's Crossing of Guadalupe River, Comal County, Texas.

Remarks.— This species is represented by a single worn specimen which has been silicified upon weathering and is very poorly preserved. The nature of the septal margins cannot be determined and the generic reference is therefore uncertain. If they are dentate, the species may belong near *Leptoria* E. & H. The apparent thickness of the walls, columella, and septa may be due to the silicification, which often tends to exaggerate the structure in such cases.

This form might be confused with *Eugyra cuyleri* Wells, 1932[88], from the lower Glen Rose formation in the same region, but the presence of a columella easily distinguishes it.

D. mariscali Felix[89] from the Neocomian of Tehuacan, Mexico, differs by its alternating septa of which the larger number 7 to 8 in a space of 5 mm., and generally lighter skeleton. *D. salisburgensis* E. & H. Prever[90] of the Cenomanian of Monte d'Ochre (Italy), is close to this form, but has only 8 to 9 septa in 5 mm.

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[88] Wells, J. W. Corals of the Trinity division of the Comanchean of Texas. Jour. of Paleont., vol. 6, no. 3, p. 237, pl. 35, fig. 4, 1932.

[89] Felix, J. Palaeontographica 37, teil 3, pt. 2, p. 161, pl. 24, figs. 4-4a, 1891.

[90] Prever, L. Anthozoa della fauna Cenomaniana dei Calcari i Scolliera. Mem. della Carta Geol. d' Italia, vol. 5, pt. 1, pp. 115-116, pl. 11, fig. 9, 1909.

Genus CYATHOPHORA Michelin 1843

Genotype. — *Astrea bourgueti* Defrance 1826. Portlandian. Europe.—*Cyathophora richardi* Michelin 1843. (By monotypy).

Cyathophora ? olssoni n. sp. Plate 6, fig. 8

Description.—Corallum subspherical, attached by a small base. The holotype has the following dimensions:

HEIGHT	MAXIMUM DIAMETER
43 mm.	50 mm.

The calices average 3.5 mm. in diameter within walls. They are of moderate depth, slightly projecting with subacute margins, spaced from 0.2 to 2.0 mm. apart. The septa are 12 in number, thin and straight. The first cycle is more prominent than the second and extends to the center of the corallum. The corallites are ribbed by short costae and are united by tabular exothecal dissepiments which are about 0.5 mm. apart, thin, and well-developed. Endotheca not observed.

Holotype.—Bureau of Economic Geology, Austin, Texas.

Occurrence: *Type locality.*— In beds of Denton (mid-Washita) age near Section 14, Block 122, western Pecos County, Texas. (Locality no. 2302, Bureau of Economic Geology Collection).

Remarks.— The holotype, like other specimens from the same horizon in Pecos county, is silicified and in bad condition. The upper surface is not preserved and the interior of the corallites is not shown.

The following is a comparison of this form and other American species referred to this genus:

SPECIES	HORIZON, REGION	CALICES	SEPTA	TABULAE
C. haysensis Wells	L. Glen Rose, Texas	3.0 mm.	10-12	10/5mm.
C. atempa Felix	Hauterivian-L. Barremian, Mexico	2.0 mm.	18-22	12-13/5 mm.
C. steinmanni Fritsche	Hauterivian, Chile	1.75-2.0 mm.	12 approx.	9/5 mm.
C. ? olssoni n. sp.	Denton Texas	3.5 mm.	6/6	10/5 mm.

Genus STEPHANOCOENIA Milne Edwards & Haime 1848

Genotype.—Madrepora intersepta Esper 1797. Recent. West Indies. (By subsequent designation, E. & H. 1850).

Stephanocoenia ? wintoni n. sp. Plate 5, fig. 9

Description.—Corallum sub-spherical, depressed, pedunculate with a broad base. Calices projecting slightly with acute margins, averaging between 2.0 and 2.5 mm. in diameter within margins, shallow. Between the calices, which are close-set or separated up to 1.0 mm., the costae, which correspond to all the septa, extend over the intercalicular areas, sometimes confluent. They are equal, rounded, with granulations. The septa are in three complete cycles, equal near the walls, non-exsert, granulate laterally, apparently entire on the upper margins. Those of the first cycle extend nearly to the columella where they terminate in a crown of small pali. The second cycle also ends in a crown of pali which is usually just outside the first ring, although it may be in the same crown as the first. The third cycle is short and extends less than half way. The columella is styliform, well-developed, sometimes compressed slightly.

Dimensions.—

	HEIGHT	DIAMETER
(Holotype)	44 mm.	68 x 74 mm.

Holtoype.—United States National Museum.

Occurrence: *Type locality.*— In the Goodman formation at Cragin's Knobs, 5 miles west of Ft. Worth, Tarrant County, Texas. (Texas Christian University Collection).

Remarks.— This species is based upon a single specimen from the Goodland beds which shows the external structure fairly well but the interior is badly preserved and shows almost nothing. *S. ? guadalupae* Wells from the lower Glen Rose is distinguished by its more projecting calices and alternating costae, but is otherwise close to this species.

Stephanocoenia ? sp.

Astrocoenia sanctisabae White 1879. U. S. Geol. Survey, Eleventh Ann. Rept. for 1877, Hayden Survey, p. 269, (listed).

Specimen.—United States National Museum No. 8314.

Occurrence: In the Buda limestone near Salado, Bell County, Texas; on Shoal Creek, Austin, Texas, (University of Texas

Collection); and on Onion Creek, near Austin, Travis County, Texas, (Texas Christian University Collection).

Remarks.—The specimen to which White referred in the above paper as "*Astrocoenia sanctisabae*", imputing the species for some unknown reason to Roemer, is identical with several large, massive specimens from the Buda limestone along Shoal Creek in Austin. Unfortunately, none of the specimens are sufficiently well-preserved to warrant description, although they very likely represent a new species. White's name has no standing, because "*Astrocoenia sanctisabae*" has never been described or figured.

The species may be either an *Astrocoenia* or a *Stephanocoenia*, probably the latter, since the walls appear to be slightly separated and single crown of what are probably pali is present. The total number of septa is 12, six large primaries extending to the center of the corallite and six shorter ones. The columella cannot be distinguished. The average diameter of the corallites is about 2.5 mm.

Family ASTROCOENIIDAE Koby

Genus ASTROCOENIA Milne Edwards & Haime 1848

Genotype.— *Astrea numisma* Defrance 1826. Eocene. France. (By monotypy).

Notes on the American Cretaceous species of this genus.—Including the three new species of *Astrocoenia* described in this paper, there are nine species of this protean genus now known from the lower Cretaceous rocks of the southern United States and Mexico. A list of them together with the formations in which they are known to occur follows:

[91]A. maloniana Vaughan 1905, Malone beds, Texas.
[92]A. whitneyi Wells 1932, Lower Glen Rose, Texas.
A. scyphoidea Wells 1932, Lower Glen Rose, Texas.
[93]A. sp. aff. A. globosa (de Fromentel) 1880, Neocomian, Tehuacan, Mexico.
[92]A. nidiformis Cragin 1895, Belvidere shale, (Champion shell

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[91] The age of the Malone beds is uncertain, but seems to be upper Jurassic.

[92] These species are discussed in the present paper.

[93] It is questionable if the Mexican species described by Felix is identical with de Fromentel's species. In the former the calices average 2.5 mm. in diameter, while in the latter they are very variable, ranging from

bed), Kansas; Comanche Peak, Texas.
[92]A. bellensis, n. sp. Comanche Peak, Texas.
[92]A. guadalupae Roemer 1849, Edwards limestone, Texas.
[92]A. pattoni, n. sp. Edwards limestone, Texas.
[92]A. budaensis, n. sp., Buda limestone, Texas.

To facilitate distinction of these species the following synopsis is presented:

1. Septa not more than 12 in number, hexamerally arranged:
   A. Corallum massive, small.
      Calices 1.0 mm. . . . . *A. bellensis* n. sp.
   B. Corallum encrusting.
      Calices 1.5 to 1.75 mm. . . . . *A. scyphoidea* Wells
2. Septa 16 to 20 in number, octamerally arranged:
   A. Corallum encrusting or massive.
      Calices 1.5 to 2.5 mm. . . . . *A. maloniana* Vaughan
   B. Corallum low, spreading or encrusting.
      Calices 1.0 mm. . . . . *A. pattoni* n. sp.
3. Septa 24 in number:
   A. Corallum low, massive, with branches.
      Calices 2.5 mm. . . . . *A.* sp. aff. *A. globosa* (de Fromentel)
   B. Corallum massive or rounded.
      Calices 2.0 to 2.5 mm.
      1. Columella small, septa thin, septa of second cycle uniting . . . . *A. guadalupae* Roemer
      2. Columella large, septa stout, not uniting . . . . *A. budaensis* n. sp.
   C. Corallum flat, spreading.
      Calices 1.25 to 1.50 mm. Septa of third cycle uniting . . . . *A. nidiformis* Cragin
   D. Corallum massive, large.
      Calices 1.5 to 2.0 mm. Septa of third cycle uniting . . . . *A. whitneyi* Wells

2.5 to 4.0 mm., according to de Fromentel. The mode of growth is also different in the two forms. The Mexican form is probably close to **A. whitneyi** Wells of the lower Glen Rose formation.

COMPARISON OF LOWER CRETACEOUS ASTROCOENIAE

SPECIES	HORIZON	FORM OF CORALLUM	CALICES	SEPTA	ARRANGEMENT OF SEPTA
A. budaensis n. sp.	Buda limestone	Massive, small	2.0 to 2.5 mm.	24	12/12
A. pattoni n. sp.	Edwards limestone	Encrusting, small	1.0	16	8/8
A. guadalupae Roemer	Edwards limestone	Massive, large	2.0 to 2.5	24	12/12
A. nidiformis Cragin	Champion Shell Bed Comanche Peak	Massive, thin, encrusting	1.25 to 1.50	24	12/12
A. bellensis n. sp.	Comanche Peak	Massive, small, thin	1.0	12	6/6
A. scyphoidea Wells	Glen Rose	Encrusting, small	1.5 to 1.75	12	6/6
A. whitneyi Wells	Glen Rose	Massive, large	1.5 to 2.5	24	6/6/12
A. sp. aff. A. globosa (de Fromentel)	Neocomian, Tehuacan	Massive, small	2.5	24	12/12
A. minima (de Fromentel) Fritsche	Hauterivian, Chile		1.0 to 1.5	20	10/10
A. hexamera Fritsche	Hauterivian, Chile	Massive	1.0 to 1.5	24	12/12
A. maloniana Vaughan	Malone Beds	Massive, small	1.5 to 2.5	16 to 20	8/8 to 10/10

Astrocoenia whitneyi Wells Plate 6, fig. 7

Astrocoenia whitneyi Wells 1932. Jour. Paleont. vol. 6, no. 3, p. 230, pl. 31, fig. 6; pl. 32, figs. 1-2; pl. 37, fig. 1.

Type and paratypes.—Department of Geology, University of Texas, Austin, Texas.

Ideotypes.—United States National Museum.

Occurrence: *Type locality.*—In the lower Glen Rose formation at Blanco Narrows, Blanco River, Blanco County, Texas.

Other locality.—The two specimens in the National Museum are from the Finlay (?) limestone at a locality two miles east of the head of Quitman Canyon, Hudspeth County, Texas. (U. S. G. S. Mes. Loc. No. 1910).

Remarks.—A broader range has been given this well-marked species by its identification from west Texas in the collection of the National Museum. The calices of one of these specimens are figured.

Astrocoenia nidiformis Cragin Plate 6, fig. 4

Astrocoenia nidiformis Cragin 1895. Colorado Col. Studies, 5, p. 50.
Astrocoenia nidiformis Felix 1914. Fossilium Catalogus, pars 7, p. 252.
Astrocoenia nidiformis Twenhofel 1924. Kansas Geol. Survey, Bull. 9, p. 51, pl. 10, fig. 4.

Description.—The following is Cragin's original description (in part):

> Stock massive, broad and low, its breadth increasing more or less from the base upward; its summit excavated, the prominent, narrowly rounded border region of the summit being irregularly lobed; cells united by rather thick walls, calices small, irregularly polygonal or slightly rounded-polygonal; columella short; septa rather stout, their free margins apparently a little uneven, their summits moderately depressed below the level of the calyx borders, the primary and secondary septa six each, short septa of the third order also appearing.

The corallum is either encrusted on shells or in the form of small convex masses from 20 to 80 mm. in diameter. The calices are polygonal, sometimes almost circular, ranging in diameter from 1.25 to 1.5 mm. The septa number 24, 12 of them reaching the columella, and the septa of the third cycle often uniting to those of the second near the columella. Owing to the small size of the calices the septa appear thin and crowded. The columella is small and styliform, not prominent, but usually appearing rather large due to the fusion with it of the first two cycles of septa.

Type.—Colorado College, Colorado Springs, Colorado. (f. Adkins, 1928).

Topotypes.—United States National Museum.

Occurrence: *Type locality.*—Champion shell bed, Kiowa member, Belvidere formation, in Champion Draw, about one-half mile south of Belvidere, southern Kansas.

Other localities.—Two specimens which I have referred to this species are from the Comanche Peak formation in the Santa Fe Railroad quarry three miles northwest of Belton, Bell County, Texas. One specimen which probably belongs to this species, comes from the Devil's River limestone at Painted Cave on the Rio Grande bank, one mile below the mouth of Pecos River, Val Verde County, Texas. (U. S. N. M. No. 21759).

Remarks.—Twenhofel, in the paper cited above, states that the calices have a diameter of about 0.75 mm. with separating walls 0.5 mm. thick. His figure, however, shows calices ranging from 1.25-1.50 mm. in diameter, exclusive of the walls.

This species is distinguished from *A. guadalupae* Romer and *A.* sp. aff. *A. globosa* (de Fromentel) Felix by the small size of the calices. In the case of the two latter species the calices are 2.0 mm. or more in diameter. The uniting of the tertiary septa to the secondaries is a feature which is also found in *A. whitneyi* Wells, a species with larger calices and a more massive growth form.

Astrocoenia guadalupae Roemer Plate 5, figs. 11-13

Astrocoenia guadalupae Roemer 1849. Texas, (etc.) pp. 391-392.

Astrocoenia guadalupae Roemer 1852. Die Kreidebildungen von Texas (etc.) p. 87, pl. 10 figs. 8a-8b.

Astrocoenia guadalupae Vaughan 1903. U. S. Geol. Survey Bull. 205, p. 39.

Astrocoenia guadalupae Felix 1914. Fossilium Catalogus, pars 7, p. 235.

Astrocoenia texana Adkins 1928.. Univ. of Texas, Bull. 2838, p. 77.

?*Astrocoenia sanctisabae* Roemer White 1879. U. S. Geol. Survey, Eleventh Ann. Rept. for 1877, Hayden Survey, p. 268, (not p. 269).

Description.—The following is a free translation of Roemer's description (1852):

> Massive colonies, spherical or bulbous, irregular, growing large, fist-like heads. The calices of the corallites slightly sunken, 1 1/3'' in diameter, distinct and regularly hexagonal in outline, joined to each other by means of a distinct common outer wall, except for interstices. Only half of the perpendicular septa reach the columella. The remaining ones are not half as long. The columella is distinct, but not prominent.

The septa are 24 in number, 12 of which representing the first two cycles, are equal and extend to the columella. Occasionally septa of the fifth cycle may be present in one or two systems. Their edges are dentate and their sides granulate. The septa of the second cycle, in well-preserved specimens are seen to be united to those of the first cycle just before the latter's union with the columella. The columella is styliform and well-developed. The dissepiments are moderately-developed, usually not preserved. In well-preserved specimens the line of union of the walls can be seen. The corallum is massive, varying from small spherical masses to fairly large convex clumps. The diameter of the calices varies from 2.0 to 2.5 mm.

Type.—University of Bonn, Bonn, Germany.

Homeotypes.—University of Texas, Austin, Texas; United States National Museum.

Occurrence: *Type locality.*—In float near New Braunfels, Comal County, Texas.

Other localities.—Six of the seven specimens examined by the author, are from the Edwards limestone at the following localities: (a) From a flint nodule from Travis County, Texas. (University of Texas Collection). (b) Edwards limestone phase of the Devil's River limestone, Devil's River, Val Verde County, Texas. (University of Texas Collection). (c) Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas, (United States National Museum). (d-f) Probably Edwards limestone, at Round Rock, Williamson County, Texas. (U. S. N. M. No. 19172).

The other specimen comes from an unknown locality. (Texas Christian University Collection).

Remarks.—This handsome species differs from *A. globosa* de Fromentel Felix (see footnote 93), and *A. nidiformis* Cragin in the size of the calices, which average 2.5 mm. in the case of the former and 1.25 to 1.5 mm. in the latter. It may also be distinguished from *A. nidiformis* Cragin by its thin, polygonal calicular walls and less crowded, non-uniting septa. It has somewhat larger calices than *A. whitneyi* Wells and the third cycle of septa is not united to the second.

In 1879 White listed *Astrocoenia sanctisabae* from near Helotes, Bexar County, Texas, attributing the species to Roemer. I have not been able to locate this specimen, but another specimen (U. S. N. M. No. 8314) thus labelled, from near Salado, Bell County, Texas, does *not* belong to *A. guadalupae* (see *Stephanocoenia* ? sp.) I have been unable to find any references other than White's, to *A. sanctisabae.*

Astrocoenia bellensis n. sp. Plate 6, figs. 5-6

Description.—Corallum small, irregular in shape, more or less thin and massive, with a flat or convex surface. Calices small, shallow, circular, or polygonal in outline, united by thick, solid walls, and averaging 1.0 mm. in diameter. Septa 12 in number, arranged in two unequal cycles. Those of the first cycle, six in number, extend to the columella; the remaining six are much shorter and reach less than half way, dropping quickly to the bottom of the calice. The upper margins of the septa are dentate, and the primaries have a large tooth on their inner ends near the columella. The columella is a small styliform tubercle projecting from the bottom of the calice.

	LENGTH	WIDTH	HEIGHT
(Holotype)	12 mm.	6 mm.	5 mm.

Holotype.—United States National Museum.

Occurrence: *Type locality.*—In the Comanche Peak formation, (middle Albian), in the Sante Fe Railroad quarry three miles northwest of Belton, Bell County, Texas. (Texas Christian University Collection).

Remarks.—This species is distinguished from *A. whitneyi, A. scyphoidea,* and *A. budaensis* by the small calices, which are rarely more than 1 mm. in diameter, whereas the calices of the three just mentioned range from 1.5 to 2.5 mm., rarely less. It is distinguished from *A. pattoni* by the septal arrangement, which is hexameral in *A. bellensis* and octameral in *A. pattoni.*

Astrocoenia pattoni n. sp. Plate 6, figs. 1-2

Description.—Corallum in the form of an irregular, thin, more or less encrusted sheet, from 2 to 10 mm. in thickness, with an undulating calicular surface. Calices polygonal, shallow, averaging 1.0 mm. in diameter within the walls. The corallite walls are thick, directly fused, the upper edges forming a thin ridge between calices, thickening below so that worn calices are separated by a rounded ridge. The septa are 16 in number. Eight of them are thick and wedge-shaped and reach the columella; the remaining eight are very short or rudimentary, but equal in thickness to the primaries at the wall. The columella is a small, styliform, tubercule projecting into the bottom of the calice. Dissepiments well-developed.

Dimensions. —

SPECIMENS	LENGTH	WIDTH
1. (Type)	35 mm.	27 mm.
2. (Paratype)	20	10

Type.—United States National Museum.

Occurrence: *Type locality.*—In the Edwards limestone, Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas. (Collected by J. Patton, 1930).

Remarks.— This species is distinguished from *A. maloniana,* the only other American species with an octameral septal arrangement, by its small calices, which are rarely more than 1.0 mm. in diameter.

Astrocoenia sp. aff. A. pattoni

Specimen.—United States National Museum.

Occurrence: In the beds of Denton age west of Godley, Johnson County, Texas. (It is likely that this locality is incorrect because the specimen closely resembles specimens from west Texas in its lithology.) (Texas Christian University Collection).

Remarks.—A small, silicified specimen in very poor condition may be related to *A. pattoni.* It is a fragment of a slightly compressed branch measuring 18 mm. in length and 10 x 13.5 in diameters. The calices average 1 mm. in diameter and are rounded polygonal in outline. The principal septa are eight in number, the rest, if any being destroyed. The columella is styliform, well-developed and prominent. All internal structure is lost.

Astrocoenia budaensis n. sp. Plate 6, fig. 3

Description.—The corallum is irregularly convex, probably forming knoblike masses. The holotype is a small corallum measuring 15 mm. in diameter and 6 mm. in height. The corallites are polygonal, closely compacted, with thick walls. The calices measure from 2.0 to 2.5 mm. in diameter, with a depth of about 0.5 mm. The septa are 12 in number, equal, stout, and reaching to the columella. The septa of the third cycle, much smaller and poorly developed, are sometimes absent in some systems and often fuse by their inner ends to the septa of the second cycle. The columella is styliform, and forms a broad tubercle in the bottom of the calice. Endotheca well-developed.

Holotype.—University of Texas, Austin, Texas.

Occurrence: *Type locality.*—In the Buda limestone on Shoal Creek at 31st Street, Austin, Texas.

Remarks.—The single specimen of this species was evidently subjected to much wear before fossilization, and any ornamentation of the upper surface of the septa and calicular walls has been obliterated. The species is characterized by the twelve strong septa reaching to the columella. By this character it is related to *A. guadalupae* Roemer, a form common in the Edwards limestone, but may be distinguished by the way in which the second cycle of septa in the latter species fuses to the first; by the thicker septa and larger columella.

The relations of this species with other species of three cycles of septa of the Cenomanian are best shown by the following table:

SPECIES	LOCALITY	FORM	CALICES	SEPTA	COLUMELLA
A. budaensis n. sp.	Texas	Small, nodular masses	2.0-2.5 mm. walls thick	12/12 uniting somewhat	large, nodular
A. cribellum Pocta	Bohemia	Flat, encrusting	0.8-1.3 mm. walls thick	6/6/12	small, tubercular
A. kunthi Bölsche	Belgium	Flat masses	2.0-2.5 mm. walls thin	12/12	small, nodular
A. retifera Stoliczka	S. India	Convex, large, nodular masses	2.0-3.0 mm. walls thick	12/12 uniting	moderate, knoblike
A. tourtiensis Bölsche	Germany	Flat masses	1.0-1.5 mm. walls thick	12/12	small, tubercular

Family ASTRANGIIDAE Verrill

Genus DENDROSMILIA Milne Edwards & Haime 1848

Genotype.—*Dendrosmilia duvaliana* E. & H. 1848. Eocene. (Lutetian). Paris Basin. (By monotypy).

Dendrosmilia ? texana (Roemer) Plate 8, fig. 11

Pleurocora texana Roemer 1888. Pal. Abh. vol. 4, pt. 4, p. 7, pl. 1, fig. 2.
Pleurocora texana Felix 1914. Fossilium Catalogus, pars 5, p. 33.
Pleurocora texana Adkins 1928. Univ. of Texas, Bull. 2838, p. 74.

Type.—University of Breslau, Breslau. (f. Adkins, 1928).

Occurrence: *Type locality.*—In the Edwards limestone on Barton Creek about one mile above its mouth, near Austin, Texas.

Remarks.—No specimens have been seen which can be referred definitely to this species. From Roemer's description and figure, however, this form does not appear to belong to *Pleurocora*. In his description he states that the septa are dentate on their inner edges and rounded on their upper margins, ("am Innenrande schwach gezhnt, oben gerundet"), and his figure shows septa with entire upper margins. He does not mention the presence or absence of pali, nor does his figure show any. *Pleurocora* has dentate septa and pali.

The reference of this species to *Dendrosmilia,* a genus with entire septa and no pali, ranging from Neocomian through the Eocene, is tentative until either the type or other specimens of *Pleurocora texana* can be examined. Roemer's figure of this species is reproduced on Plate 8, figure 11.

Family OCULINIDAE Milne Edwards & Haime

Genus ARCHOHELIA Vaughan 1919

Genotype.—*Archohelia limonensis* Vaughan 1919. Pliocene. Costa Rica. Florida. (By original designation).

Archohelia sp. Plate 8, fig. 1-2

Specimen.—United States National Museum.

Occurrence: In the Edwards limestone, Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas. (Collected by J. Patton, 1930).

Remarks.—One very much worn fragment is referred to this genus. It is a fragment of a branching corallum showing three corallites, measuring 18 mm. in height. The axial corallite is slightly compressed and has an interior diameter of 3.5 x 4 mm. toward the base of the corallum, and a diameter of 5 x 6 mm. at the opposite end. One small corallite has diameters of 2.5 x 3 mm. The wall is thick and solid. The exterior is worn perfectly smooth. The axial corallite has four complete cycles of septa. Those of the first two are equal and thick, bearing pali on their inner ends and united to the columella. The septa of the third cycle are shorter and thinner and extend about two thirds of the distance to the columella, while those of the fourth cycle are about half as long. The upper margins of the septa cannot be determined, but their sides are laterally beaded by spreading rows of ascending granulations. Endotheca is poorly developed. The columella is fascicular, small, elongated, and united to the inner paliform ends of the septa.

This species is not named, owing to the fragmenary nature of the specimen, but the generic assignment is quite certain. Heretofore *Archohelia* has not been found lower than Eocene except a new species, *A. dartoni,* from the Mancos shale of New Mexico (Turonian), which is much smaller than the present form.

Genus PLACOHELIA Pocta 1887

Genotype.—Placohelia rimosa Pocta 1887. Cenomanian. Kuttenberg. Bohemia. (By monotypy).

Notes on the genus.—Pocta[92] founded this genus on a single specimen in which the internal characters were not well known. He experienced much difficulty in discriminating between the columella and pali, because they appeared to be arranged in a single row along the long axis of the calice as shown in his Plate 2, fig. 7. This would be a very unusual arrangement of pali which are usually found on the inner ends of the septa forming a ring around the columella. It is more likely that the structure he referred to the columella and pali are all part of a laminar, fasciculate columella. The inner ends of some of the larger septa in his figure are thickened and may represent pali. In spite of the uncertainty surrounding this genus, the species described below seems more nearly referable to it than to any other of the Oculinids.

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[92] Pocta, P. Anthozoen der Böhmischen Kreide formation, p. 49, 1887.

Placohelia ? richardsi n. sp. Plate 8, figs. 3-4

Description.—Corallum small, low, massive, pedunculate, attached by a small base in younger stages, becoming knoblike or subspherical in larger specimens. Corallites relatively large, bounded by a thick wall, separated and united by a dense costulated coenenchyme. Calices projecting with sharp margins, deep, nearly circular or more often elliptical in outline, the larger ones measuring 6 x 7 mm., the average being 5 x 6 mm., nearly 2 mm. in depth. The septa are in four complete cycles in mature calices, non-exsert, their upper margins finely dentate and concave, laterally granulate. The septa of the first two cycles are equal and prominent, with small, indistinct pali at their inner ends. The fourth cycle often united with the third cycle and these last two cycles are thinner than the principal septa. The laminar columella, composed of several closely united fascicular ribbons, parallels the longer axis of the calice, and is united to the larger septa by trabecular processes. The costae are low, rounded and separated by equally broad interspaces, not confluent between the calices. Increase is by lateral budding.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS	NO. OF CALICES
1. Type)	9.5 mm.	18 x 20 mm.	6
2. (Paratype)	12	12 x 20	5
3. "	9	16 x 17	4
4. "	6	8.5 x 12	6
5. "	27	25 x 30	40 ?

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—All of the specimens except No. 2 come from the Comanche Peak formation in the Sante Fe Railroad quarry three miles northwest of Belton, Bell County, Texas.

Other locality.—Specimen No. 5, a large, round, much eroded corallum, comes from the Edwards limestone on the north bluff of Bluff Creek, near Kickapoo Springs, Edwards County, Texas. (U.S.G.S. Mes. Loc. No. 1601).

Remarks.—Compared with the type species, this species has smaller calices with more septa. Pocta states that the larger calices in *P. rimosa* average about 6 x 10 mm., with 20 to 30 septa.

This species occurs with *Favoidioseris fredericksburgensis* in the Comanche Peak formation and young specimens of both species resembles each other quite closely. They may be distinguished by the differences in mode of increase and by the smaller number of septa and solid coenenchyme in the present form.

Genus PLEUROCORA Milne Edwards & Haime 1848

Genotype.—Lithodendron gemmans Michelin 1847. Senonian. Corbières. France. (By monotypy).

Notes on the genotype.—Although in 1850 Milne Edwards and Haime[93] designated *P. explanata* E. & H. as the genotype, in their original diagnosis[94] only *Lithodendron gemmans* Michelin is given as an example. Therefore the latter species becomes the genotype by monotopy.

Pleurocora coalescens Roemer Plate 8, figs. 9-10

Pleurocora coalescens Roemer 1888. Pal. Abh., vol. 4, pt. 4, pp. 7-8, pl. 1, fig. 3.

Pleurocora coalescens Grabau & Shimer 1909. North American Index Fossils, vol. 1, p. 100.

Pleurocora coalescens Felix 1914. Fossilium Catalogus, pars 5, p. 33.

Pleurocora coalescens Adkins 1928. Univ. of Texas, Bull. 2838, p. 74.

Description.—Corallum branching, low small, increasing by dichotomous or trichotomous fission. Corallites free laterally, average 3 mm. in diameter, variable in length up to 10 to 12 mm., devoid of any epitheca and covered by prominent costae corresponding to all the septa. These costae are equal, rounded, but sometimes somewhat acute, beaded on their edges and separated by deep, narrow, granulated interspaces. Calices circular or distorted by fission, of medium depth. Septa from 20 to 36 in number, equal in thickness, irregular in arrangement, laterally granulated, upper margins apparently dentate, uniting irregularly. About half of the septa reach the columella, which is well-developed and spongy. Endothecal dissepiments poorly developed.

Types.—University of Breslau, Breslau.

Tophomeotypes.—United States National Buseum.

Occurrence: *Type locality.*—In the Edwards limestone one mile above the mouth of Barton Creek, near Austin, Texas.

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[93] Milne Edwards, H. and Haime, J. Introd. British Fossil Corals, Pal. Soc. London, p. viii, 1850.

[94] Milne Edwards, H. and Haime, J. Compt. rend Acad. Sci. Paris, vol. 27, p. 494, 1848.

Other localities.—(a) At Deep Eddy Bluff, Colorado River, Austin Texas. (United States National Museum). (b) One quarter mile east of the south end of Quitman Mountains, Eagle Mountain Quadrangle, Texas (a doubtful specimen). (c) In Bluff Creek, near Kickapoo Springs, Edwards County, Texas. (U.S.G.S. Mes. Loc. No. 1601).

Remarks.—Although Roemer states that there are four cycles of septa in this species, no specimens were found possessing more than 36 septa, equalling 3 complete cycles and half of a fourth. The specimens as a rule have the calices very poorly preserved and the presence or absence of pali is hard to determine, and it is possible that they may not be present.

Reproduction in *Pleurocora,* according to its authors[95], is by budding, but fission is common in the Gosau species according to Oppenheim[96].

This species is markedly different from the type and other upper Cretaceous species, most of which are low *espalier*-like forms, with only the upper parts of the corallites free.

Family ORBICELLIDAE Vaughan

Genus ORBICELLA Dana 1846

Genotype.—*Madrepora annularis* Ellis & Solander 1786. Recent. West Indies.

Synopsis of American Cretaceous species.—

Orbicella is well represented in the lower Cretaceous rocks of Texas. The synopsis follows.—

A. Calices less than 10 mm. in diameter.
  1. Septa decamerally arranged . . . . **O. ? texana* Vaughan
  2. Septa hexamerally arranged in 3 cycles:
    a. Septa of 3rd cycle uniting to those of 2nd cycle. Calices 2.5 mm. . . . . **O. pecosensis* n. sp.
    b. Septa of 3rd cycle not uniting.
    aa. Columella papillary, calices 1.3 to 1.7 mm. . . . . *O. travisensis* Wells
    bb. Columella well-developed, spongy.

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[95] Milne Edwards, H. and Haime, J. Histoire Naturelle des Corallaires, vol. 2, p. 601, 1857.

[96] Oppenheim, P. Anthozoen der Gosauschichten, p. 365, 1930.

aaa. Calices 1.2 to 1.5 mm. . . . . *O. edwardsensis* n. sp.
bbb. Calices 3.4 to 4.0 mm. . . . . . . *O. roemeriana* n. sp.
cc. Columella, weak, trabecular.
aaa. Calices 1.5 to 2.0 mm. . . . . . . *O. whitneyi* Wells
bbb. Calices 2.0 to 2.5 mm. . . . . *O. whitneyi* var.
ccc. Calices 1.25 mm. . . . . *O. ? sp.*
B. Calices 12 mm. in diameter; septa 18 in number, alternating . . . . *O ? comalensis* Wells
*Discussed in this paper.

Orbicella whitneyi var. Plate 2, fig. 18

Orbicella whitneyi Wells 1932. Jour. Paleont. vol. 6, no. 3, p. 239, pl. 32, fig. 6.

Specimen.—United States National Museum.

Occurrence: In a dense, light gray limestone of Aptian age at Bufa, "near trail to top at 7050 feet", Ojuela, Mapini, (Durango), Mexico. U.S.G.S. Mes. Loc. 13973).

Remarks.—A single specimen from the region noted above is particularly interesting because of its possible bearing on the origin of the lower Glen Rose Urgonian coral fauna in Texas. It is evidently closely related to *O. whitneyi* but has larger corallites, ranging in diameter from 2.0 to 2.5 mm., approaching the variety of *O. whitneyi* cited in the synonymy. The septa are 24 in number, the first two cycles being equal and larger than the third, which is very short. The columella is well-developed but is not clearly shown in the corallites of the specimen. The figure shows a diagram of a corallite of the Mexican specimen.

Orbicella edwardsensis, n. sp. Plate 6, figs. 9-10

Description.—Corallum massive, consisting of small nodular proliferations which are often closely compacted into larger masses. The type specimen measures 80 x 115 x 50 mm., in width, length, and height. Corallites cylindrical, with a thin wall, united by non-confluent costae and a well-developed exotheca. Calices projecting slightly, with prominent, acute margins, ranging from 1.2 to 1.5 mm. in diameter within the walls. Septa in three complete cycles, thin, equal, in thickness, dentate on the upper margins and laterally granulate, non-exsert. Those of the first two cycles are equal and unite with the columella. The third cycle is short and extends about half way to the columella, not uniting with the first or second cycles. Endotheca well-developed. Columella well-developed, spongy, and prominent. Costae thin, equal, and acute with rounded interspaces on the upper surface, corresponding to all the septa, meeting in the interspaces below but not confluent. Exotheca well-developed.

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—In the Edwards limestone at Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas. (Collected by J. Patton, 1930).

Remarks.—This species is marked by its well-developed columella and is distinguished from the nearest species, *O. roemeriana,* by its smaller calices. Associated with this species are *Archohelia* sp., *Astrocoenia pattoni,* and *A. guadalupae* Roemer.

Orbicella roemeriana, n. sp. **Plate 7, figs. 6-7**

Description.—Corallum subspherical of hemispherical, pedunculate. Corallites cylindrical, with a thin wall, united by costae and exotheca. Calices shallow, circular, ranging from 3.0 to 4.0 mm. in diameter, spaced from 1 to 2 mm. apart, margins acute when unworn. Septa in three complete cycles, heavily granulated laterally, dentate on the upper margins, relatively thin. Those of the first cycle are often more prominent than the rest and fused to the columella. Second cycle often equal to the first and almost reaching the columella. The third cycle short, the upper margins dropping quickly about half way to the columella. Columella well-developed, spongy. Endotheca poorly-developed. Costae equal and acute when well-preserved, separated by shallow interspaces, meeting those of other calice between calices but not regularly confluent and thicker than the septa to which they correspond.

Dimensions.—

Specimen	Length	Width	Height
1. (Type)	65 mm.	48 mm.	?
2. (Ideotype)	90	70	48 mm.

Type.—Department of Geology, University of Texas, Austin, Texas.

Ideotypes.—Department of Geology, University of Texas, and United States National Museum.

Occurrence: *Type locality*.—The type is from the Edwards limestone in central Texas, exact locality unknown, probably in Kerr County.

Other localities.—One ideotype is from the Devil's River limestone, Val Verde County, Texas, (University of Texas Collection), and a second comes from the Edwards limestone at the Rob Roy Ranch, Travis County, Texas. (United States National Museum).

Remarks.—The first ideotype has slightly smaller calices and a smaller columella than the type specimen, but otherwise closely corresponds to it.

This species has larger corallites than any of the other Texas lower Cretaceous species of the genus, except *O. ? comalensis*. It is easily distinguished by the alternate septa and well-developed columella.

The third specimen which may belong to this species measures 65 x 115 x 65 mm. It is a hemispherical mass badly preserved in a flint nodule and shows the calices and septa vaguely. All internal structure has been obliterated.

Orbicella pecosensis, n. sp. Plate 7, figs. 2-5

Description.—Corallum small, massive, rounded, knoblike and pedunculate. Corallites cylindrical, united by a well-developed exotheca but not by the costae with a thin wall. Calices circular, averageing 2.5 mm. in diameter, shallow, slightly projecting with acute margins, separated by low, costulated interspaces up to 1.5 mm. wide. Septa in three complete cycles, equal in the vicinity of the wall, laterally granulated, united by a well-developed endotheca, dentate on the upper margins, non-exsert. Those of the first cycle are free and thicker than the rest, reaching to the columella. The second cycle is joined by the third cycle near the columella. Usually the second cycle extends to the columella. The columella is poorly-developed, appearing in cross-section as a few processes between the ends of the first cycle of septa. The costae corresponding to all the septa are very short and non-confluent within the corallum, and appear on the surface as acute, beaded ridges with broad, shallow, intercostal grooves.

Dimensions.—

	HEIGHT	DIAMETER
(Holotype)	45 mm.	30 mm.

Holotype.—Department of Geology, University of Texas, Austin, Texas. (Collected by F. L. Whitney).

Occurrence: *Type locality.*—In the upper cap rock (Main Street formation) at University Mesa near Ft. Stockton, Pecos County, Texas.

Remarks.—This species is distinguished from *O. whitneyi* and *O. edwardsensis* by its larger calices and the uniting of the 3rd cycle to the 2nd. *O. edwardsensis* has a more well-developed columella. *O. travisensis* has a papillary columella and thick walls. *O. roemeriana* has larger calices.

Only one specimen of this species is now known, but it is well-preserved and shows the internal structure well in section.

Orbicella ? sp.

Description.—Corallum small, convex, massive, nodular. Calices shallow, bounded by thin walls, averaging 1.25 mm. in diameter separated by very small interspaces. Septa in three complete cycles, thin, laminar, very slightly granulated laterally, upper margins unknown. Those of the first two cycles are equal, the secondaries fusing to the primaries at the junction with the columella. Tertiaries very short. Costae short and thin, non-confluent. Exotheca present. Columella composed of a few straggling processes.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS
1.	13 mm.	16 mm.
1.	20	40

Specimens.—Bureau of Economic Geology, Austin, Texas, No. 565.

Occurrence.—In the lower Fredericksburg near Milliken Mountain, Coke County, Texas, with *Turritella vibrayeana* d'Orb. and *Modiolus sp.*

Remarks.—The two specimens of this species are very poorly preserved and the form is not named at present. The calices are smaller than any of the other species considered here. *O. whitneyi,* from the lower Glen Rose, has calices ranging from 1.5

to 2.0 mm. and has the same weak columella. *O. edwardsensis*, from the Edwards limestone, has calices from 1.2 to 1.5 mm., but has a better developed columella. The calices in this species are also more closely set than in other forms.

The reference to *Orbicella* is made uncertain by the lack of knowledge of the septal edges, although all of the other characters are typical of the genus.

Orbicella ? texana Vaughan Plate 7, fig. 1

Orbicella ? texana Vaughan 1903. U. S. Geol. Survey Bull. 205, p. 38, pl. 26, fig. 1, pl. 27, fig. 6.
Orbicella texana Felix 1914. Fossilium Catalogus, pars 7, p. 168.
Orbicella texana Adkins 1928. Univ. of Texas, Bull. 2838, p. 75.

Type.—United States National Museum.

Tophomeotypes.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—In the lower (?) beds of the Buda limestone on Shoal Creek, Austin, Texas.

Remarks.—Although several specimens of this species are now known, none of them are sufficiently preserved to make the generic disposition certain. Vaughan's type in the National Museum remains the best specimen. It does not show the exterior of the corallum, but the internal structure is well-preserved. The septa are always 20 in number, irregularly arranged cyclically, there being 10 principal ones which are relatively large and 10 smaller ones. Their inner ends are cribriform. The character of their upper edges has not been observed. The columella is very poorly-developed, consisting of a few processes joining the inner septal ends. The costae are short and never join between the corallites, the intervening area being filled with a well-developed exotheca, consisting of horizontal layers spaced about 0.25 mm. apart. In one specimen a small portion of the surface of the corallum is exposed. The calices are slightly projecting, circular in outline with the wall partly hidden by short thick costae. The intercalicular area is traversed by the costae for a very short distance, the rest being covered by large granulations.

The very poorly-developed columella short costae, and granular intercorallite areas make the reference to *Orbicella* doubtful, the last two features being more characteristic of *Cyphastrea.* Because of the poor condition of the specimens I am leaving the species for the present in *Orbicella.*

The specimen figured, from the University of Texas Collection, represents the cast of a low, spreading corallum which encrusted the shell of an *Exogyra;* the other specimens observed are larger nodular heads.

Family THECOSMILIIDAE

Genus CLADOPHYLLIA Milne Edwards & Haime 1831

Genotype.—*Lithodendron dichotomum* Goldfuss 1826. Portlandian. Germany. (Genolectotype, Wells 1933).

Note on the genotype.—Milne Edwards and Haime[97] did not designate a type species for this genus, but they seem to have founded it on the species noted above, and since it is the first on their list, it is here selected as the genotype.

Cladophyllia furcifera Roemer Plate 8, figs. 5-8

Cladophyllia furcifera Roemer 1888. Pal. Abh., p. 8, pl. 1, figs. 4a-4b.

Cladophyllia furcifera Grabau & Shimer 1909. North American Index fossils, p. 100, text fig. 462.

Cladophyllia furcifera Felix 1914. Fossilium Catalogus, pars. 5, p. 41.

Cladophyllia furcifera Adkins 1928. Univ. of Texas, Bull. 2838, p. 74.

? ? Cladophyllia furcifera Hodge 1920. New York Acad. Sci., Sci. Surv. of Porto Rico, vol. 3, pt. 2, p. 192.

Description.—Corallum low and bushy, the cylindrical corrallites being separated by considerably more than their own diameters, dichotomizing frequently, occasionally reproducing by calicular gemmation and frequently meeting and coalescing. The diameter of the corallites varies from 2.5 to 7 mm. The calices are circular, unless distorted by fission, and from 1 to 1.5 mm. deep. There are three cycles of septa. They are equal in the first two cycles, non-exsert, lightly dentate, extending to the center of the calice where two of them may meet and fuse. The third cycle is small and thin and extends less than half-way. There is no columella, although the meeting in the center of the calice of the septa may simulate one. Endotheca is well-developed and regular. The exterior is covered by a strong, wrinkled epitheca.

Type.—University of Breslau, Breslau. (f. Adkins, 1928).

Tophomeotypes.—United States National Museum.

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[97] Milne Edwards, H. and Haime, J. Mon. des Pol. foss. Terr. paleozoiques, p. 81, 1851.

Occurrence: *Type locality.*—One mile above the mouth of Barton Creek, Austin, Texas. (U.S.N.M. No. 12242).

Other localities.—(a) Deep Eddy bluff, Colorado River, Austin, Texas, (U.S.N.M. No. 22982). (b) Old Ft. Mason, near Burnet, Burnet County, Texas, (U.S.N.M. Nos. 19176 and 19177). (c) North bluff of Bluff Creek, near Kickapoo Springs, Edwards County, Texas, (U.S.G.S. Mes. Loc. 1601). (d) In Bell County, Texas.[98]

Remarks.—Roemer's figures of this species are accurate but do not show the bushy corallum, although good specimens are very uncommon; usually small branches alone are found. Roemer states that the diameter of the corallites varies from 4 to 6 mm., but a greater variation is noted in the foregoing description. This species is the only representative of the genus found in beds younger than the Neocomian and the genus is best represented in the upper Jurassic.

Felix[99] has has described *C. miroi* from the Hauterivian-lower Barremian, of Tehuacan, Puebla, Mexico, but his figures are poor. This species differs from the present form by its shorter septa and taller, more nearly fasciculate rather than bushy corallum with smaller corallites (2 mm.).

At the type locality on Barton Creek, this species occurs in a caprinid layer with *Pleurocora coalescens* Roemer, *Dendrosmilia ? texana* (Roemer), and *Parasmilia austinensis* Roemer. Most of the specimens are beautifully preserved pseudomorphs of calcite.

Hodge, in the paper cited above in the synonymy identifies with this species "two calyxes of a coral" found in a limestone in the Coamo-Guayama district of Porto Rico. It is doubtful if this identification is correct.

Family FAVIIDAE Gregory

Genus FAVIA Oken 1815

Genotype.—*Madrepora fragum* Esper 1795. Recent. West Indies. (By elimination, Gregory, 1900).

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[98] Adkins, W. S., Geology of Bell County, Texas, **Univ. of Texas, Bull.** 3016, p. 35, 1930.

[99] Felix, J. Versteinerungen aus der mexikanischen Jura- und Kriedeformation. **Paleontographica**, bd. 37, theil 2, p. 153, pl. 25, figs. 10-10a, 1891.

Favia texana Cragin Plate 2, fig. 15

Favia texana Cragin 1893. Geol. Survey of Texas, Fourth Ann. Rep. p. 145, pl. 24, fig. 1, pl. 46, fig. 5.

Favia texana Felix 1924. Fossilium Catalogus pars 7, p. 250.

Favia texana Adkins 1928. Univ. of Texas Bull. 2838, p. 76.

Description.—Corallum massive, rounded, Cragin's type specimen measuring 78 x 90 x 40 mm. in width, length, and height. Calices projecting slightly, very variable in shape from circular through elliptical and elongate to trilobate, due to fission, averaging 3.5 mm. in diameter in the circular calices, and 3 x 5 or 3.5 x 6 mm. in the elongate ones, bounded by thin walls, close-set or separated by as much as 2 mm. Septa variable in number, depending upon the condition of the calice, 36 in a corallite 3.5 in diameter, 26 in one 3.0 mm. in diameter, and 38 in another elliptical corallite 3 x 5 mm. They are much thickened near the wall, but soon become thin and flexuous toward the columella. Sometimes nearly all the septa extend to the columella, but usually there is a tendency to alternate in length. Laterally they are granulate and united by endotheca. The columella is loose and trabecular, not well-developed. The costae correspond to all the septa and extend between the corallites, usually not confluent and united by an abundant, well-developed exotheca.

Holotype.—The type specimens of most of the other species described in Cragin's paper are in the collections of the University of Texas, but the holotype of *Favia texana* could not be located.

Plesiotype.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—Edwards (?) limestone float at Pilot Knob, Travis County, Texas. (f. Cragin).

Other locality.—Edwards (?) limestone near Austin, Texas.

Remarks.—Cragin's description does not mention the number and arrangement of the septa nor the columella, but the specimen upon which the above description is based fits other details well, and probably represents Cragin's species.

The specimen examined is a silicified boulder of uncertain origin, much worn but showing the internal structure well enough, and which is probably from the Edwards limestone. Cragin's specimen was a calcitized mass from float at Pilot Knob, Travis County, and may also have been derived from the

Edwards limestone. Cragin, in his description, states that the corallites are united by a thick wall. This condition may have been due to destruction of the intercorallite tissue by calcitization. The plesiotype cannot well be illustrated by a photograph and has been figured by a diagram of the cross section of several corallites.

Suborder FUNGIDA Dana

Family OULASTREIDAE Vaughan

Genus DIPLOASTREA Matthai 1914

Genotype.—*Astrea heliopora* Lamarck 1816. Recent. South Pacific. (By original designation).

Notes on the genus.—The main points of difference between *Diploastrea* and *Oulastrea* are that in the former the edges of the septa are covered by large teeth which are nearly uniform in size, whereas in the latter, as exemplified by *O. crispata,* the septal teeth are very small except near the columella, where there are large paliform teeth at the ends of the septa. These structures are difficult to differentiate in the case of fossil specimens, but can often be seen in a longitudinal section. In the case of *D. harrisi*[100] of the Glen Rose, I was able to infer the condition of the septal edges in this manner and show that they were characteristic of *Diploastrea.* In the case of *D. ? vaughani,* however, this could not be determined accurately and for this reason the generic reference is questionable.

Synopsis of American lower Cretaceous species.—

1. Corallum massive;
    - a. Calices 3-4 mm., septa 24-30 .... *D. hilli* n. sp.
    - b. Calices 4.5-5 mm., septa 30-36 .... *D. harrisi* Wells
2. Corallum encrusting;
    - Calices 2-3.5 mm. septa 38-44 .... *D. ? vaughani* n. sp.

Diploastrea hilli, n. sp. Pl. 2, figs. 13-14; pl. 8, fig. 12

Description.—Corallum massive, small, hemispherical or subspherical. Corallites cylindrical, bounded by a nearly imperforate, synapticular wall, averaging a little more than 3 mm. in diameter, and the distance between them ranges from 1 to 2 mm. The septa vary in number from 24 to 30, the usual number being 24. They regularly alternate in size, the thicker ones extending to the columella. They are laterally granulate and somewhat perforate near the columella to which the larger are joined by trabeculae. The columella is trabecular in structure, not greatly developed but distinct. Endothecal dissepiments present, well-developed, arched upwards and inwards. The exotheca is more or less tabular in its arrangement and not as abundant as the exotheca. Between the corallites the equal septo-costae are usually directly confluent. Synapticulae are rare and found only in the vicinity of the wall.

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[100] Wells, J. W. Corals of the Trinity Group of the Comanchean of Central Texas. **Jour. Paleont.,** vol. 6, no. 3, p. 248, pl. 38, figs. 5-6, 1932.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS
1. (Type)	32 mm.	approx. 50 mm.
2. (Paratype)	52	65 x 75

Type and paratype.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—Comanche Peak (?) formation at Leon Springs, Pecos County, Texas.

Other localities.—The paratype is from a locality at a "little mountain northwest of 12 Mile Mountain" (Mesa), Pecos County, Texas. (Both specimens collected by R. T. Hill in 1920).

Remarks.—The average size of the corallites in the paratype is larger than in the type, being nearly 4.0 mm. This difference is probably accounted for by the fact that the specimens are from different localities.

This species is very close to *D. harrisi* Wells of the lower Glen Rose formation, the main difference being that in that species the corallites are larger, averaging 4.5 to 5.0 mm., and the septa are more numerous, 30 to 36, and uniting.

Diploastrea ? vaughani, n. sp. Pl. 8, figs. 13-14

Description.—Corallum low, flat, encrusting, up to about 8 mm. thick. Corallites cylindrical, bounded by nearly imperforate synapticular walls. Calices shallow, projecting, circular or slightly deformed, united by well-developed septo-costae, averaging 2.75 mm. in diameter, ranging from 2 to 3.5 mm., separated from 0.5 to 3.0 mm. The septa vary in number from 38 to 44. They are nearly equal at the wall, with a tendency toward alternation in thickness, and half of them fusing to the longer septa irregularly, and only the longer ones extending to the columella. They are laterally granulate and have small dentations on their upper edges, (as inferred from the structure of the interior). The inner ends of 8 to 10 of the larger septa in some of the better-preserved calices show pronounced thickenings which may represent paliform teeth. Their inner edges are perforate and the trabeculae project inward as processes which fuse with the columellar tangle. The columella is trabecular, well-developed and spongy in appearance. The septa are continuous with the septocostae which are usually, but not always, confluent between corallites, their upper edges being subacute and apparently smooth. Endothecal and exothecal dissepiments are abundant. Synapticulae rare except near the columella and occasionally near the wall. The common wall is not well shown by the specimens, but appears to have been covered originally by a thin epitheca, and non-costulate.

Dimensions.—

SPECIMEN	THICKNESS	LENGTH & BREADTH
1. (Type)	7 mm.	46 x 38 mm.
2. (Paratype)	2	32 x 23

Types.—United States National Museum.

Occurrence: *Type locality.*—In the Edwards limestone at Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas.

Remarks.—The two specimens of the species are silicified. The upper surfaces are much worn but the internal structure is beautifully preserved. The encrusting growth-form of this species is unusual for this genus and distinguishes the species from *D. harrisi* Wells, of the lower Glen Rose, and *D. hilli* of the Comanche Peak, species which have much larger and closer-set calices with fewer septa.

The presence of what appear to be paliform teeth in this species makes the generic reference doubtful. If they do represent pali, the species is probably closer to *Oulastrea* or *Cyathomorpha*.

The corallum of this species originates as a single corallite which is attached by a base broader than the calice, and which attains considerable height before lateral budding produces additional calices. In the case of the paratype this parent still predominates, remaining near the center of the corallum while most of the increase is supplied by marginal budding near the edges of the corallum.

Family ISASTREIDAE Koby, emended.

Type genus.—*Isastrea* Milne Edwards and Haime 1851. Anisian-Miocene (?).

Diagnosis.—Colonial fungids with imperforate laminar septa with the superficial aspect of the genera belonging to the family *Faviidae.* Corallites distinct, either united directly by the walls or by confluent septo-costae. Wall synapticular, compact. Both synapticulae and dissepiments exist. Columella trabecular, well-developed or absent. Asexual reproduction by fission.

Remarks.—This family, as it is now emended, contains genera formerly placed in both the *Aporosa* and *Fungida.* It includes part of the subfamily *Comoserinae* of Gregory[101] and part of his *Isastreidae.*[102] Gregory states (p. 155) that *Comoseris* has septa similar to *Thamnasteria* s.s., and cites *C. maeandrinoides* (Michelin) as the type species. This species is clearly an Microsolenid, as is also *C. irradians* E. & H., as examples of these species in the National Museum, as well as Koby's figure[103] of the former, show.

The *Isastreidae* bears the same relation to the Faviidae as the *Oulastreidae* to the *Orbicellidae*, and includes several of the genera formerly referred to the *Faviidae* and the *Agariciidae.* I would include in it the following genera:

Isastrea E. & H. 1851.[104] Genotype: *Astrea helianthoides* Goldfuss 1827.

Complexastrea d'Orbigny 1849. Genotype: *Astrea burgundiae* Leymerie 1846=*A. burgundiae* de Blainville, 1830 ?.

Archaeoseris Gregory 1900. Genotype: *A. thamnastroides* Gregory 1900.

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[101] Gregory, J. W., The corals; Jurassic fauna of Cutch. **Pal. Indica,** ser. 2, vol. 9, pt. 2, p. 30, 1900.

[102] Gregory, J. W., op. cit., p. 29.

[103] Koby, F., Pol. jur. de la Suisse, pt. 9, pl. 130, fig. 7, 1890.

[104] Not all of the species referred to this widely used but really poorly known genus belong to the fungids. A general revision of the genus is needed.

Coeloseris Vaughan 1918. Genotype: *C. mayori* Vaughan, 1919.

Latomeandra E. & H. 1849. Genotype: *Lithodendron plicatum* Goldfuss 1827.

Dimorphophyllia Reuss 1864. Genotype: *Meandrina collinaria* Catullo 1856.

Favioseris Wells (MS.) Genotype: *F. anomalos* Wells (MS.)

Synopsis of the genera.—

1. Calices simple, distinct, not in series.

A. Columella absent.
  a. Corallites united directly by walls . . . . *Coeloseris*
  b. Corallites united by short septo-costae, calices large . . . . *Complexastrea*
  c. Corallites united by long septo-costae, calices small . . . . *Favioseris*

B. columella parietal or slightly-developed.

  a. Corallites united by walls; columella parietal or absent . . . . *Isastrea*
  b. Corallites united by septo-costae; columella spongy . . . . *Favoidioseris*

2. Calices in long or short series.

A. Series short; corallites free near margins; septa coarsely dentate . . . . *Latomeandra*

B. Calices serial; radiating from a central corallite.
  a. Series short, columella absent . . . . *Archaeoseris*
  b. Series long, sinuous; columella trabecular, discontinuous . . . . *Dimorphophyllia*

Genus FAVOIDIOSERIS n. gen.

Genotype.— *Favoidioseris fredericksburgensis* n. sp. Comanche Peak formation. Bell County, Texas.

Diagnosis of genus.—Corallum massive, usually forming relatively small hemispherical, nodular or low convex masses. Epitheca absent, common wall solid and costae. Corallites short, with synapticular, compact walls, united by confluent septo-costae and abundant exotheca. Calices variable in depth, elliptical or irregularly rounded, very little projecting. Septa nonexsert, thin, compact, laminar, lightly dentate on the upper margins, numerous, most of them uniting with the columella. They are not much thickened near the wall. Columella trabecular, usually well-developed and spongy. Synapticulae present in the region of the wall. Endotheca and exotheca developed. Reproduction is usually by sub-equal fission, as in *Favia.*

Remarks.— This genus is created to contain members of the *Isastreidae* which have the general aspect of *Favia,* but which possess confluent septo-costae and synapticulae. It is separated from *Complexastrea, Coeloseris,* and *Favioseris* by the presence of a columella, and from *Isastrea* by the separation of the corallites and their union by well-developed septo-costae.

Septastrea ambigua (Michelin) de Fromentel[105] (Cenomanian) almost certainly belongs in this new genus. From de Fromentel's figures and text it is clear that it is a fungid and is probably very close to *F. pecosensis,* n. sp. from the lower Washita. Hinde[106] pointed out that this species was not a *Septastraea,* but did not refer it to any other genus. *Favia baumbergeri* and *Favia schmidto* Koby[107] (Urgonian) may belong here also. Koby states that these forms are marked by their confluent septo-costae. *F. turbinata* de Fromentel[108] (Urgonian) appears to belong to this genus. *Favia stricta* E. & H.[109] from the upper Greensand of Haldon, probably belongs here also.

Favoidioseris fredericksburgensis, n. sp. Pl. 8, figs. 15-18

Description.— Corallum low, relatively broad, almost encrusting. The young corallum is tuberous or knoblike, and pedunculate. Calices circular through oval or elliptical to irregularly rounded, frequently distorted by fission, with diameters of 3.5

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[105] Fromentel, E. de. **Pal. franc. Terr. crét., Zooph.** p. 485, pl. 133, fig. 1, 1879.

[106] Hinde, C. J. On the history and character of the genus **Septrastraea** d'Orbigny and the identity of its type species with that of **Glyphastraea** Duncan. **Quart. Jour. Geol. Soc. London,** vol. 44, p. 224, 1888.

[107] Koby, F. Pol. crét. de la Suisse, pp. 49-50, 52-53, pl. 6, fig. 2, pl. 10, figs. 5-5a, 1898.

[108] Fromentel, E. de. Pol. foss. de l'ét. Néocomien, p. 35, pl. 5, figs. 1-2, 1857.

Fromentel, E. de. Pal. franç. Terr. crét., Zooph., p. 483, pl. 119, fig. 2, 1875.

Koby, F. Pol. crét. de la Suisse, p. 51, pl. 10, figs. 1-4, 1898.

[109] Milne Edwards, H. & Haime, J. British Fossil Corals, p. 59, pl. 10, fig. 3, 1850.

to 7.0 mm. in the more circular ones, and 3 x 4 mm. to 6 x 9 mm. in the elliptical ones. Most of them are elliptical and have average diameters of 6 x 8 mm. The distance between them over the intercorallite areas is from 1.5 to 3.0 mm. They are shallow when unworn, becoming deep when weathered. Corallite walls thin, synapticulate, with few or no perforations. The septa range in number from 40 to 70, usually 55 to 60 in the average calices. They are thin, straight, non-exsert, heavily granulated on their sides and lightly dentate on their upper edges, irregularly arranged and less than half of them extend to the columella, the rest usually uniting to the lower septa. Through the corallite wall they are continuous with the septo-costae, which are equal, of the same thickness as the septa with nearly acute upper margins and broad interspaces and directly confluent. The columella is trabecular, spongy, not very prominent, small, but well-developed. Endotheca poorly-developed. Exotheca well-developed and regularly disposed. Synapticulae developed near the wall. Reproduction is usually by sub-equal fission, although unequal fission often occurs, producing small calices.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS	
1. (Paratype)	16 mm.	70 x 78 mm.	
2. (Type)	18	40 x 62	
3. (Paratype)	15	31 x 40	
4. "	7	25(?) x 30	
5. "	13	21 x 26	
6. "	7	14(?) x 18(?)	
7. "	7	10 x 13	(4 calices)
8. "	13	11 x 13	(4 calices)
9. "	9	11 x 17	(12 calices)
10. "	7	8 x 12	(8 calices)

Type.— United States National Museum.

Paratypes.— Numbers 4, 8, 9, and 10 are in the United States National Museum. Numbers 1, 3, 5, 6, and 7 are in the Texas Christian University Collection.

Occurrence: *Type locality.*— The typical form and the variety *alta* occur in the Comanche Peak formation in the Santa Fe Railroad quarry 3 miles northwest of Belton, Bell County, Texas.

Other locality.— Two small specimens of the typical form, paratype 10 and another, come from the Edwards limestone, Hiram Hall Ranch, 35 miles west of Kerrville, Kerr County, Texas. Although the calices in these specimens average somewhat smaller than in the Comanche Peak specimens, there are no other observable differences.

Remarks.— This species may be readily distinguished from *F. pecosensis,* n. sp., but its smaller calices with fewer septa and its low, spreading, rather than turbinate, growth-form. In the typical form the calices are but slightly projecting or flush with the surface. One specimen, however, from the same locality as the type specimen, appears to represent a distinct variety, and is here distinguished as *F. fredericksburgensis* var. *alta* .

F. fredericksburgensis var. alta, n. var. **Pl. 8, fig. 19**

Description.— This variety is distinguished from the typical form of the species by its smaller, projecting calices, which average 4 x 5 mm. in diameter, projecting to a height of 3.5 mm. above the surrounding interspaces. The septa range from 50 to 60 in number, thin, laminar, and uniting. Septo-costae confluent and rounded, thicker than in the typical form. Synapticulae present. Columella trabecular, small, not as well developed as in the typical form.

Favoidioseris pecosensis, n. sp. **Pl. 9, figs. 4-5**

Description.— Corallum hemispherical, with a broad flat or pedunculate base. The common wall is devoid of an epitheca and is compact and costulate. Corallite wall thin, not well-developed. Calices large, separated by interspaces from 2 to 10 mm. wide, shallow unless weathered, circular, elliptical or trifoliate in outline, with rounded or acute margins. The diameter varies from 8 to 10 mm. in circular calices to as much as 12 x 15 mm. in elongate calices. They are equal, thin, laminar, straight, non-exsert, lightly dentate, and laterally granulate, about half of them extending to the columella. They are continuous with the septo-costae. The latter are equal to the septa in size and are confluent between the calices. They are slightly narrower than their interspaces. Columella trabecular, spongy, but not large. Endotheca scanty, exotheca highly developed. Sub-equal fission.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER
1. (Type)	40.0 mm	55 mm.
2. (Paratype)	37.5	40 x 48
3. "	41.0	60 x 65
4. "	31.0	57 x 61
5. "	34.0	35

Type.— United States National Museum.

Paratypes.— Numbers 2 and 4 are in the United States National Museum, numbers 3 and 5 are in the collection of Texas Christian University.

Occurrence: *Type locality.*— In the beds of Denton age in section 14, block 122, western Pecos County. (Collected by J. C. Miller).

Remarks.— Specimens of this species are silicified and much distorted, the calices often being weathered to a considerable depth. The species is much larger than the type of the genus, *F. fredericksburgensis,* and is very close to *F. ambigua* (de Fromentel)[110] from the Cenomanian of France, although in this latter species the columella, according to de Fromentel, is false, being formed by the fusion of the inner ends of the septa.

Specimen 2 listed above differs from the others in that the calices are more widely separated and have acute margins. This form may represent a variety like variety *alta* of *F. fredericksburgensis,* but does not present any other differences from the typical form.

Family ANTILLOSERIDAE n. fam.

Type genus.— *Antilloseris* Vaughan 1905. Eocene.

This name is proposed for Vaughan's family *Micrabaciidae.* Elsewhere in this paper I have shown that the former type genus of the family, *Micrabacia,* is a perforate coral related to the Eupsammids but forming a separate family in the suborder *Perforata.* *The* removal of the genus *Micrabacia* to the perforate corals leaves a number of genera belonging to a group of family importance and Vaughan's diagnosis of the family remains unchanged, but the family no longer contains *Micrabacia* and does not include any genera in which the costae correspond to the intercostal spaces. For the type genus of this family I have selected *Antilloseris* Vaughan,[111] a well-known form which shows well the characteristics of the family as given by Vaughan:[112] *simple fungids with solid septa and perforate wall.* Other genera of this family are: *Microsmillia* Koby, *Podoseris* Duncan, *Vaughanoseris* Wells (MS.), *Cyclabacia* Bölsche, and *Zittelofungia* Duncan (?). No representatives of this family are known from the Cretaceous of the United States.

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[110] Fromentel, E. de. **Pal. franç. Terr. Crét., Zooph.,** p. 486, pl. 133, fig. 1, 1879.

Synopsis of family.—

- I. Septa imperforate:
    - A. Epitheca present:
        - 1. Columella well-developed; corallum with narrow base; mural pores regular . . . . *Microsmilia* Koby
        - 2. Columella small; base variable; mural pores irregular; dissepiments present . . . . *Podoseris* Duncan
        - 3. Columella spongy; corallum free; low; mural pores irregular; dissepiments present . . . . *Vaughanoseris* Wells (MS.)
    - B. Epitheca absent; columella absent; mural pores irregular; dissepiments absent; corallum trochoid or cylindroconical . . . . *Antilloseris* Vaughan
- II. Septa uncertain; corallum plano-convex; costae developed; no epitheca . . . . *Cyclabacia* Bölsche
- III. Wall uncertain; corallum discoid, plano-convex; septa numerous; epitheca present . . . . *Zittelofungia* Duncan

Family TROCHOSERIDAE n. fam.

Type genus.— *Trochoseris* Milne Edwards and Haime 1849.

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[111] Vaughan, T. W. Critical review of the literature of the simple genera of the Madreporaria fungida with a tentative classification. U. S. Nat. Mus., Proc. vol. 28, p. 390, 1905.

[112] Vaughan, T. W. op. cit. p. 386.

Sequanian-Miocene.

Diagnosis of family.— Simple fungids with imperforate septa, imperforate walls, and dissepiments.

Remarks.— This name is proposed to include those *simple* genera of the *Fungida* which were formerly placed in the family *Agariciidae* Verrill. This latter family, as it thus is restricted, includes only colonial genera.

Synopsis of family.—

I. Corallum trochoid or turbinate; pedicellate;
  A. Epitheca absent:
    1. Columella absent:
      a. Pali absent:
        aa. Corallum turbinate .... *?Turbinoseris Duncan*
        bb. Corallum compressed, fan shaped .... *Phegmatoseris Milasch*
      b. Pali present:
        Corallum compressed .. *?Elliptoseris Duncan*
    2. Columella rudimentary, papillary .... *Trochoseris* E. & H.
  B. Epitheca present:
    1. Columella rudimentary ...... *Palaeoseris* Duncan
    2. Columella absent .... *Thecoseris* de From.
II. Corallum discoid, free; epitheca absent:
  A. Septa in deltas, distant; wall thin .... *Bathyactis* Mosely
  B. Base polygonal in outline ...... *?Gonioseris* Duncan

Genus TROCHOSERIS Milne Edwards & Haime 1840

Genotype.— *Anthophyllum distortum* Michelin 1844. Eocene. (Lutetian). Paris basin. (By monotypy).

Trochoseris shattucki, n. sp. Pl. 7, fig. 6; Pl. 9, figs. 1-3

Description.— The corallum is simple, low, conical, attached at the base, flaring or enlarging rapidly. The type specimen has a diameter of 23 mm. at the calice and 9.0 mm. near the base, and a height of 11.5 mm. The wall is imperforate, covered by low, rounded, granular costae, devoid of an epitheca. The calice is superficial, circular in outline with a shallow central fossa. The septa are numerous, exsert, uniting, alternating slightly in thickness, solid, with the upper edges marked by rounded dentations, laterally covered with stout granulations. They are 114 in number in the type specimen, of which 18 extend into the fossa and join the columella. The columella is poorly developed, mostly formed by trabecular expansions of the inner ends of the septa. Synapticulae are poorly developed except in a narrow zone near the wall. There are no dissepiments.

Types.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the lower beds of the Buda limestone 3 feet from the top of Shoal Creek near "The Oaks" and 26th Street, Austin, Texas.

Remarks.— *Trochoseris* is typically an upper Cretaceous and early Tertiary genus. Only two other species are known from the Cenomanian, *T. constricta* Duncan, and *T. morrisi* Duncan[113] from the upper Greensand of Haldon, England. The latter species is near the present one but is more conical in shape and does not flare as rapidly. *T. constricta* is proportionately taller with a broader base.

Family AGARICIIDAE Verrill

Genus SIDERASTREA de Blainville 1830

Genotype.— *Madrepora radians* Pallas 1766. Recent. West Indies (=*Madrepora galaxea* Ellis and Solander 1786). (By subsequent designation, Milne Edwards and Haime, 1850).

Siderastrea tuckerae n. sp. Pl. 9, figs. 6-7

Description.— Corallum small, hemispherical, subspherical or irregularly convex, appearing in the weathered state to be composed of concentric layers of corallites. Calices polygonal when close-set, slightly rounded when separated, ranging from 2.5 to 4.0 mm. in diameter, averaging about 3.0 mm. Shallow, with sharp margins in polygonal calices, and rounded in the separated ones. Septa from 35 to 45 in number, usually nearer 40, irregularly arranged, thin, nearly equal, uniting, and about half of them extending to the columella. Columella spongy, well-developed. Corallite walls synapticular, thin, fused or slightly separated. Synapticulae present, well-developed in the vicinity of the wall.

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[113] Duncan, P. M. On the upper Greensand fauna of Haldon, Devonshire. **Quart. Jour. Geol. Soc. London**, vol. 35, pp. 93-94, pl. 8, figs. 11-12; 13-15, 1879.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS
1. (Type)	25 mm.	37 x 46 mm
2. (Paratype)	29	34 x 40
3. "	29	36 x 40
4. "	22	24 x 26
5. "	45	97 x 75

Type.— Bureau of Economic Geology, Austin, Texas.

Paratypes.— United States National Museum; Texas Christian University; Bureau of Economic Geology, Austin, Texas.

Occurrence: In beds of Denton age at the following localities:

Type locality.— In section 14, block 122, western Pecos County, Texas. (Type and paratype number 4, Bureau of Economic Geology No. 2302; paratype number 2, United States National Museum). Collected by J. C. Miller.

Other localities.— (a) Extreme western Pecos County, Texas. (paratype number 3, Texas Christian University Collection); (b) University Mesa, Ft. Stockton, Pecos County, Texas (paratype number 6, Bureau of Economic Geology Collection Number 1026).

Remarks.— The only other species of *Siderastrea* now known from the American lower Cretaceous is *S. cuyleri* Wells,[114] occurring in the Travis Peak formation (lower Trinity=Aptian). It has fewer septa, (from 24 to 36), and 8 to 12 of them reach the columella. It is probably related to the present species. Aside from these two species, only two others have been reported from the Cretaceous, *S. cretacea* Söhle[115] from the Cenomanian of Bavaria, and *S. cretacea* Bölsche[116] of the New Jersey upper Cretaceous. Söhle's figures are unsatisfactory and he gives no description. Bölsche's species is considered later in this paper.

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[114] Wells, J. W. Corals of the Trinity group of the Comanchean of central Texas. **Jour. Paleont.**, vol. 6, no. 3, p. 243, pl. 37, fig. 9, pl. 39, fig. 1, 1932.

[115] Söhle, U. Geologische Aufnahme des Labergebirges bei Oberammergau mit Besonderer Berucksichtigung des Cenomans in den bayrischen Alpen. **Geognost. Jahrshefte**, vol. 9, 1897.

[116] Bölsche, W. Polypi. In: Credner Kreide von New Jersey. **Zeitschr. deutsch. geol. Ces.**, vol. 22, p. 216, 1870.

Nineteen silicified specimens of *S. tuckerae* have been examined. Most of them are badly preserved and nearly all detail is destroyed. Seventeen of them are small, hemispherical masses with flat or concave bases; paratype number 5, from University Mesa, is a large, irregularly convex mass.

Genus STEPHANOMORPHA Vaughan 1900

Genotype.— *Stephanomorpha monticuliformis* Vaughan 1900. Lower Eocene. Alabama. (By original designation).

Stephanomorpha ? saxi-rotundi, n. sp. Pl. 10, figs. 16-17

Description.—The corallum is branching, but the growth-form is not well shown in the type specimen, which measures 21 mm. in height and 22 mm. in width. The calices are irregularly placed about 1.5 mm. apart, and are circular, occasionally slightly oval, slightly protruding, shallow and measuring from 1.0 to 1.5 mm. in diameter, bounded by a perforate synapticular wall. The septa number from 20 to 22 and are stout, imperforate, crenulated, and strongly granulated on their sides. About 10 of them extend to the center and join the columella. Some of the smaller septa appear to unite and before them are paliform lobes. The number of these pali cannot be determined exactly, but not more than one crown seems to be present. The columella is styliform, forming a small tubercule in the bottom of the calice. The septo-costae, which correspond to the septa, extend over the walls and between the calices, and are confluent with those of other calices. In structure they are somewhat perforate, heavily granulated on their upper edges.

Holotype.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— In the Buda limestone, 8 feet from top of the lower beds, on Brushy Creek, Round Rock, Williamson County, Texas.

Remarks.— This species is represented by a fragment showing the junction of two branches and is in a poor state of preservation due to infiltration of secondary calcite. It is so different from *S. monticuliformis* Vaughan,[117] from the lower Eocene of Alabama, that its position in *Stephanomorpha* is very doubtful, but there seems to be no other genus of the Agaricids to which it can be assigned. The wide separation of the calices, the branching corallum, and the more or less perforate septo-costae readily distinguish it from the type species mentioned above. Better specimens may show that the internal structure is considerably different than that of the Agaricids and what appear as septo-costae on the surface of the corallum may represent a reticulate coenenchyme as in *Actinacis.*

Genus THAMNASTERIA Lesauvage 1823

Genotype.— *Astrea dendroidea* Lamouroux 1821. Bajocian. Caen. (By monotypy).

Thamnasteria hoffmeisteri, n. sp. Pl. 2, fig. 21; pl. 10, figs. 18-19

Description.— The corallum is massive, formed of superimposed, laminar, convex layers, attaining a diameter of 75 mm. and a height of 35 to 40 mm. The calices are superficial and scattered without order over the surface of the colony. Their centers are on the average about 3 mm. apart. There is no corallite wall and the septa are confluent between the calices. The septa are laminar in structure, of medium thickness, equal in size, from 15 to 20 in number, depending upon the size of the corallite, the usual number being 18. Their upper edges are granular and their sides are horizontally ribbed by rows of synapticulae. Perforations occasionally exist near the inner margins. The columella is papillose and not prominent, joined to the inner ends of 10 or 12 septa. A few dissepiments are present. Increase is by marginal gemmation.

Type.— Department of Geology, University of Texas, Austin, Texas.

Ideotype.— United States National Museum.

Occurrence: *Type locality.*— In the lower beds of the Buda limestone on Brushy Creek, Round Rock, Williamson County, Texas.

Remarks.— This species may readily be distinguished from

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[117] Vaughan, T. W. Eocene and lower Oligocene faunas of the United States with a few doubtfully Cretaceous species. **U. S. Geol. Survey Mon.** 39, p. 157, pl. 18, figs. 5-7, 1900.

Dimorpharaea manchacaensis by its compact, laminar septa which are fewer in number, and by its lack of a concentric arrangement of the corallites about a larger central corallite. It is distinguished from *Dimorphastrea stantoni* (below) by its massive growth-form and irregular arrangement of the corallites which have thinner septa.

It differs from other Cenomanian species of the genus by the smaller size of the corallites.

Genus DIMORPHASTREA d'Orbigny 1850

Genotype.— *Dimorphastrea grandiflora* d'Orbigny 1850. Neocomian. Saint Dizier, France. (By subsequent designation, E. & H. 1850).

Dimorphastrea stantoni, n. sp. Pl. 10, figs. 10-15

Description.— Corallum small, pedunculate, with a small expanded base, convex upper surface and costate common wall. The calices are superficial, radiating concentrically from a central parent calice. The distance between calicular centers averages 5 mm. The septa vary in number from 16 to 20 in the smaller calices to 36 to 40 in the central calices, of which number nearly all extend to the columella. In structure the septa are solid, thick, laminar, united by numerous synapticulae and beaded on the upper margins. Viewed in longitudinal section their trabecular structure can be seen and some perforations exist. The septo-costae are short, continuous with the septa and directly confluent between the corallites. The columella is poorly developed, consisting of a few papillae.

Galley 36 Wells Wells

Dimensions.—

Specimen	Height	Diameter of Upper Surface	Diameter of Base
1. (Type)	11 mm.	15 mm.	7 mm
2. (Paratype)	12	17	7
3. “	13	9	10
4. “	11	11	7
5. “	12(?)	22.5	?
6. “	?	25(?)	?

Type.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— Lower beds of the Buda limestone near Manchaca, Travis County, Texas.

Remarks.— This species is close to *D. patellaris* Stoliczka[118] from the Cenomanian of southern India, which usually has four complete cycles of septa in the central calice and three in the smaller ones. *D. vario-septalis* Bölsche[119] from the middle Hilsconglomerat (Barremian) of Alpenstedt, Hanover, is a species whose mode of growth and general form closely resemble *D. stantoni.* The number of septa, however, is much greater.

It is distinguished from *Thamasteria hoffmeisteri* by the presence of a large central parent corallite and by its pedunculate growth-form.

Family LEPTOPHYLLIIDAE Vaughan

Genus LEPTOPHYLLIA Reuss 1850

Genotype.— *Leptophyllia clavata* Reuss 1854. Senonian. Gosau. (+ *L. irregularis* Reuss). (By monotypy).

There are several species in the Buda limestone which apparently belong to this genus, but the specimens are too poorly preserved to warrant specific designation.

Leptophyllia sp. 1 Vaughan

Leptophyllia sp. 1 Vaughan 1903. U. S. Geol. Survey Bull. 205, p. 39, pl. 27, figs. 9-11.

Leptophyllia sp. 1 Adkins 1928. Univ. of Texas, Bull. 2838, p. 77.

Specimen.— United States National Museum.

Occurrence: In the Buda limestone on Shoal Creek, Austin, Texas.

Remarks.— The type of this form in the National Museum remains the only specimen collected up to this time.

Leptophyllia sp. 2 Vaughan

Leptophyllia sp. 2 Vaughan. U. S. Geol. Survey Bull. 205, p. 39, pl. 27, figs. 7-8.

Leptophyllia sp. 2 Adkins. Univ. of Texas, Bull. 2838, p. 77.

Specimen.— United States National Museum.

Occurrence: In the Buda limestone on Shoal Creek, Austin, Texas.

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[118] Stoliczka, F. Cretaceous fauna of southern India. **Pal. Indica**, ser. 8, vol. 4, p. 45, pl. 10, fig. 2, 1873.

[119] Bölsche, W. Die Korallen des nordeutschen Jura und Kreidebirges. **Zeitshr. deutsch. geol. Ges.**, vol. 18, p. 477, pl. 9, figs. 5-6, 1866.

Remarks.— This form is also represented only by the type specimen in the National Museum.

Leptophyllia sp. 3

Specimen.— Department of Geology, University of Texas, Austin, Texas.

Remarks.— One large individual is included here. It is wretchedly preserved, having been riddled by boring mollusks and badly worn so that only an irregular mass is left. At present it measures 32 mm. in height and 42 mm. in diameter near the calice. The shape apparently was subturbinate with a broad base. The septa number considerably more than 200 and are perforate-lamellate in structure, the pores filling up in the lower part of the corallum. There is no columella. Synapticulae are well-developed and abundant.

This form is distinguished by its size, being much larger than either of the two preceeding species.

Genus PROTETHMOS Gregory 1900

Genotype.— *Protethmos oldhami* Gregory 1900. Bathonian. Cutch, India. (By original designation).

Protethmos budaensis, n. sp. Pl. 2, figs. 7-9; pl. 10, figs. 1-4

Description.— The corallum is simple, free, subturbinate, or cylindro-conical, straight or curved, often constricted slightly at intervals due to interruptions in growth. The wall is thin, variable in development, being formed by both septal thickening and dissepiments. The calice of the type specimen is not well preserved but in specimen number 7 it is circular and shallow and represents the greatest diameter of the corallum. In one or two specimens, however, the greatest diameter occurs a short distance below the edge of the calice. This condition is found in other genera of the corals in the case of senile individuals. The septa vary in number from 75 to 95, the average being around 80. They are about equal in thickness, but only 30 or 40 extend to the center of and join the columella. They are strongly granulated, even spinulose, on their sides, dentate on their upper edges and slightly exsert. In structure they are laminar, perforate near the columella and near the calice. In some specimens the perforations are almost entirely absent due to filling. The columella is parietal and poorly developed. The costae correspond to the septa and are equal in size, strongly granulated and distinct from the base upwards. Synapticulae are rare, occurring only near the wall. Endotheca is developed slightly in the peripheral area and considerable exotheca is present between the costae. There is no epitheca.

Dimensions.—

SPECIMEN	LENGTH	MAXIMUM DIAMETER
1. (Type)	40 mm.	16 mm.
2. (Paratype)	35	13
3. "	30	12
4. "	31	10
5. "	27	11.5
6. "	22	22
7. "	32	20
8. "	16	11

Specimens number 5 and 6 are unusually broad for their length and might well be termed varieties of the normal elongate form.

Type and paratypes.— Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*— Lower beds of the Buda limestone on Shoal Creek at 31st Street, Austin, Texas.

Other localities.—On Brushy Creek at Round Rock, Williamson County; near Manchaca, Travis County, Texas.

Remarks.— Specimens of this species occur commonly in the Buda limestone so completely calcitized that all but the exterior is obliterated.

This species is distinguished from the genotype *P. oldhami* Gregory[120] from the upper Jurassic of India by lack of a broad basal expansion.

The presence of this species in the lower Cretaceous affords a link between the upper Jurassic forms of the genus and those reported from the upper Eocene of St. Bartholomew by Vaughan.[121]

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[120] Gregory, J. W. The corals; Jurassic fauna of Cutch. **Pal. Indica** ser. 2, vol. 9, pt. 2, p. 164, pl. 18, figs. 10-13, 1900.

Protethmos sp.

Dimensions.—

SPECIMEN	CALICULAR DIAMETER	HEIGHT
1.	22 mm.	9 mm.
2.	15(?)	16

Specimen.— United States National Museum.

Occurrence: "Zone just below the Hippurite Zone", Edwards limestone on Bluff Creek 5 miles west of Crawford, McLennan County, Texas. (U. S. N. M. Loc. 3270).

Remarks.— Two specimens are referred to this genus. They are fragments of a simple, conical or turbinate species closely related to *P. budaensis.* The corallite wall is costate, perforate, devoid of an epitheca, and lacks the exothecal development found in the Buda form. The costae are thin, acute, granular laterally, with broad interspaces. The septa number about 96 in the better specimen. They are unequal, those of the first three cycles thicker than the rest and almost imperforate except near the columella. The remaining septa are thin and perforate almost to the wall, and some of the smallest ones have a tendency to unite with the larger. The columella is spongy but poorly developed. Endotheca is scanty, being developed only near the walls.

Genus FRECHIA Gregory 1900

Genotype.— *Frechia cornutiformis* Gregory 1900. Bathonian. Cutch, India. (By original designation).

Frechia ? boesei, n. sp. Pl. 2, fig. 12

Description.— Corallum small, free, varying in shape from conical to cornute, low, expanding rapidly. Calice circular or elliptical, almost superficial. Wall perforate, indistinct, dissepimental in origin, very thin. Septa thin, nearly straight, perforate, not filling up below, laminar in appearance, with lateral spines or granulations, nearly equal in size, those of the higher cycles tending to unite with the longer septa. Septa variable in number, numerous, from 100 to 140, of which from 25 to 40 extend to the center and unite to form a small parietal columella. Synapticulae present but not abundant. Dissepiments absent.

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[121] Vaughan, T. W. Fossil corals from Central America, Cuba, and Porto Rico, with an account of the American Tertiary, Pleistocene, and Recent Coral reefs. U. S. Nat. Mus., Bull. 103, p. 194, 1919.

Exterior of corallum not preserved.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER
1. (Type)	5+ mm.	12.5 mm.
2. (Paratype)	8	14.5
3. "	8.5	9 x 11.5
4. "	4+	8.5 x 10
5. "	7+	9.5 x 12.5

Type.— United States National Museum.

Paratypes.— United States National Museum; Texas Christian University Collection.

Occurrence: *Type locality.*— The type and paratypes 3, 4, and 5 come from the Walnut formation 5 miles northwest of Georgetown on the road to Leander, Williamson County, Texas. (United States National Museum).

Other locality.— Paratype 2 is from Cragin's Knobs, 5 miles west of Ft. Worth, Tarrant County, Texas. (Texas Christian University Collection).

Remarks.— Specimens of this species are very close to *Frechia* ? sp. from the Buda limestone. They are poorly preserved and in most cases the costae and wall have been entirely destroyed, leaving only the interior of the corallum.

The wall in this species as well as in the next two is different from that of *Frechia* as it is presumed to be by Vaughan,[122] in that it is dissepimental rather than the result of septal thickening and synapticular development.

Frechia shumardi, n. sp. Pl. 2, fig. 11

Description.— Corallum simple, free, cornute or subconical in shape, expanding rapidly. Calice elliptical, with a deep central fossette. Wall thin, perforate, dissepimental in origin, usually not preserved. Septa thin, equal, not very straight, perforate, but filling up more than in the preceding species. In number they are from 80 to 120, depending upon the size of the corallum. The columella is parietal, poorly developed, and is found at the bottom of the deep fossette. Dissepiments and synapticulae only in the vicinity of the wall.

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[122] Vaughan, T. W. Critical review of the literature of the simple genera of the madreporaria fungida with a tentative classification. **U. S. Nat. Mus., Proc.** vol. 28, p. 396, 1905.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER OF CALICE
1. (Type)	9.5 mm.	11.5 x 15 mm.
2. (Paratype)	9.0	13.5 x 15

Type.— United States National Museum.

Occurrence: In the Walnut formation 5 miles northwest of Georgetown on the Leander road, Williamson County, Texas.

Other locality.— The large specimen comes from the same formation west of Leander on the Bagdad road, Williamson County, Texas. (United States National Museum).

Remarks.— This species, while it is close to *F. ? boesei* and occurs at the same horizon, is distinguished by the presence of a deep calicular fossette and relatively fewer septa in proportion to its size. Otherwise the two forms are similar. The wall in this species is formed as in *F. ? boesei,* not by septal thickening as in typical *Frechia*, but dissepimental development. This feature serves to distinguish these two species from *Protethmos sp.,* in which there is considerable septal thickening.

One specimen, which probably belongs to this species, measures 15 mm. in height with calicular diameters: 19 x 24 mm., shows that the septa are essentially trabecular in structure with lateral prolongations of the separate trabeculae project as spines, although in transverse section the septa appear laminar.

Frechia ? sp. Pl. 10, fig. 9

Dimensions.—

SPECIMEN	HEIGHT	MAXIMUM DIAMETERS
1.	6.5 mm.	8 x 10 mm.
2.	6.0	7 x 9

Specimens.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: In the Buda limestone on Shoal Creek, Austin, Texas.

Remarks.—Two small specimens are included here. Both are very badly worn and neither shows the exterior of the corallum. In shape they are cornute, short and slightly compressed. The calices are inclined in the direction of the shorter axis. The septa are highly perforate and number about 100.

This form is distinguished by its small size and characteristic shape. It is unnamed for the present until better and more complete specimens are found. It is close to *F. ? boesei* of the Walnut formation but is a much smaller form with fewer septa.

Family ANABACIIDÆ Duncan

Genus PARACYCLOLITES n. gen.

Genotype.—*Paracyclolites bakerae* n. sp. Buda limestone. Central Texas.

Diagnosis of genus.—The corallum is simple, small, pedunculate and fixed by a small base, or free, convex above, more or less conical below. Wall, thin, indistinct, perforate. Calice circular, convex with a central circular fossa. Septa numerous, uniting, trabeculate in structure, every fourth or fifth one thicker and with the pores obliterated, as in *Cyclolites elliptica*[123]. Synapticulae small and not well-developed. No dissepiments. The columella is small and papillary, formed by 4 or 5 ascending rods, projecting but little from the bottom of the fossa. No epitheca.

Remarks.—This genus groups with *Anabacia* E. & H., *Cyclolites* Lamark, *Trochoplegma* Gregory, *Trocharaea* Etallon, *Cyclolitopsis* Reuss, and *Paracycloseris* Wells (MS.). By the structure of the septa it most closely resembles *Cyclolites*, but differs from that genus by its form, lack of epitheca and presence of a columella, which is essential. By this latter character is may also be distinguished from *Anabacia*, *Trochoplegma*, *Trocharaea*, and *Cyclolitopsis*.

It differs from *Paracycloseris* by the absence of an epitheca and smaller columella.

The following table shows the main features of the genera of the *Anabaciidae*:

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[123] Vaughan, T. W. U. S. Nat. Mus., Proc., vol. 28, p. 405. 1905.

GENUS	FORM	EPITHECA	SEPTA	COLUMELLA
Cyclolites	Plano-convex Free	Present	Trabeculate. Larger ones more or less solid.	Absent
Cyclolitopsis	Plano-convex Fixed	Present	Trabeculate	Absent
Paracycloseris	Plano-convex or sub-conical Free	Present	Trabeculate. Larger ones more or less solid, uniting	Papillate, Large
Paracyclolites	Convex, low, conical, fixed or free	Absent	Trabeculate. Larger ones more or less solid, uniting	Papillose, Small
Anabacia	Plano-convex Free	Absent	Trabeculate, fusing very little	Absent
Trochoplegma	Conical, low pedunculate or free	Absent	Trabeculate, fusing below	Absent
Trocharaea	Broad base, pedunculate or free	Absent	Trabeculate, trabeculæ uniting below in short series	Parietal

Paracyclolites bakerae n. sp. Pl. 2, fig. 19; pl. 10, figs. 5-8

Description.—The corallum is simple, free or attached, convex on the calicular surface, conical below, tapering abruptly to a blunt base in the free specimens. The maximum diameter of the type specimen at the rim of the calice is 17.0 mm. The maximum height is 9.5 mm. and the height of the calicular margin above the base is 7.0 mm. The wall is not shown in the type, but in another specimen it is indistinct and perforate. The calice is circular and convex with a central, round fossa of moderate depth. The septa are trabeculate in structure, those of the first three cycles being thick with pores obliterated, appearing prominently in the calice and projecting slightly into the fossa. The remaining septa are much thinner, porous, and uniting, subequal, decreasing in size somewhat in the higher cycles. Their upper edges are granulated and their sides show lateral granular expansions of the trabeculae. The total number of septa in the type is about 200. In another smaller specimen which is bassally attached there are 96 septa. In this latter specimen the distal ends of the septa appear through the wall as low, equal costae. The synapticulae are not well-developed and are irregular in their arrangement. No dissepiments can be seen. The columella, which appears in the bottom of the fossa as a low papillary projection, is essential and composed of 4 or 5 small rods. The outer surface shows no trace of an epitheca.

Type.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—Upper layers of the lower beds of the Buda limestone on Brushy Creek, Round Rock, Williamson County, Texas.

Other locality.—Same beds on Shoal Creek, Austin, Texas.

Family MICROSOLENIDÆ Koby

Genus DIMORPHARAEA de Fromentel 1861

Genotype.—*Microsolena koechlini* Milne Edwards and Haime 1860. Corallian, France. (By subsequent designation, Koby, 1888).

Dimoropharaea manchacaensis n. sp. Pl. 11, figs. 5-9

Description.—The corallum is colonial, low, expanding, convex and pedunculate, each colony possessing a central corallite larger than the rest, surrounded by one or more concentric rings of smaller calices. The type specimen has a diameter of 55 mm. and has two concentric rings of corallites, the first at a distance of 10 to 12 mm. from the center, and the second at a distance of 6 to 8 mm. from the calice centers of the first. The calices are superficial, slightly sunken in the center around the columella, the large central calice of the type specimen having a diameter of 14 mm., the others about 7 mm. The septa in the central calice number 86, of which 15 reach the center; in the smaller calices there are from 30 to 35 septa, of which 9 to 10 reach the center. There is no corallite wall and the septa merge into septo-costae which are confluent between the calices. There are about 12 septo-costae within a space of 5 mm. The septal structure is trabeculate-fenestrate, as in *Microsolena,* the septa being formed of vertical rows of trabeculae which are regularly swollen, forming a lattice-like or fenestrated plate. Synapticulae are abundant. In the septa of the lower cycles the trabeculae are fused together for short distances, giving a solid appearance to these septa. The columella is a simple style, appearing as a small knob within the calices surrounded by a ring of 6 or 8 more or less detached trabeculae which simulate pali. The lower surface of the corallum is marked by low, rounded costae, devoid of epitheca.

Type.—Department of Geology, University of Texas, Austin, Texas.

Occurrence: *Type locality.*—Lower beds of the Buda limestone in the first creek south of Manchaca, Travis County, Texas.

Other localities.—Same beds along Shoal Creek, Austin; and on Brushy Creek, at Round Rock, Williamson County, Texas.

Remarks.—This appears to be the first species of this genus to be found in the Cretaceous. It may be compared with *D. lycetti* (Duncan) from the Bajocian of England, specimens of which were examined in the National Museum. Fragmentary specimens of this form might be confused witth *Dimorphastrea stantoni* or *Thamnasteria hoffmeisteri,* but may be distinguished by determining the septal structure, which is moniliform in

Dimorpharaea and other Micrsolenians when viewed in transverse section, and more or less solid and distinctly laminar in *Dimorphastrea* and *Thamnasteria*.

Suborder PERFORATA Milne Edwards and Haime

Family HETEROCOENIIDÆ Oppenheim

Genus HETEROCOENIA Milne Edwards and Haime 1849

Genotype.—*Lithodendron exigue* Michelin 1847. Turonian. Bouches-du-Rhone, France. (By subsequent designation, M. E. & H., 1850).

Heterocoenia ? washitaensis n. sp. Pl. 11, figs. 3-4

Description.—Corallum small, subspherical, pedunculate. Corallites cylindrical, small, separated by nearly their own diameters and united by more or less parallel or concentric layers of cellular coenenchyme. The external diameter of the corallites average 2.25 mm. The calices are small, projecting, with thick, rounded, non-costulate margins, averaging 1.75 mm. in diameter, spaced about 1.5 mm. apart. The septa are 12 in number radially arranged, six of them much larger than the remainder, but not extending to the center of the corallite. The rest are merely ridges within the corallite. There is no columella. There are no costae. The layers of coenenchyme may be as much as 2 mm. in thickness and are .5 to 1.5 mm. apart. On weathered specimens it is seen to be finely cellular in structure.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER (APPROX.)
1. (Type)	25 mm.	40 mm.
2. (Paratype)	20	37

Type.—United States National Museum.

Paratype.—Bureau of Economic Geology, Austin, Texas.

Occurrence: Type locality.—In beds of Mainstreet age in section 14, block 122, western Pecos County, Texas. (Collected by J. C. Miller).

Remarks.—The reference to *Heterocoenia* in this case is tentative. The specimens are silicified and very poorly preserved, the septa in nearly every case being completely obliterated and the upper surface of the corallum destroyed.

Heterocoenia ? hilli Wells[124] from the lower Glen Rose is distinguished from this species by its branching mode of growth. *Heterocoenia provincialis* (Michelin)[125] of the European Turonian and Senonian, possesses slightly larger calices and only six septa. In *Heterocoenia exigua* (Michelin)[126] the calices are more projecting and the corallum has a laminar growth form.

Family ACROPORIDÆ Verrill

Genus ACTINACIS d'Orbigny 1849

Genotype.—Actinacis martiniana d'Orbigny (1849) 1850. Turonian-Senonian. France, Germany, Austria. (By monotypy).

Actinacis valverdensis n. sp. Pl. 11, figs. 1-2

Description.—Corallum subdenroid, evidently consisting of finger-like branches with stubby rounded ends. The holotype is a fragment of such a branch averaging 12 mm. in diameter with a length of 22 mm. The calices are projecting, separated from .5 to 2.0 mm., scattered irregularly with an average diameter of 1 mm. They are shallow and bounded by a well-defined wall. The septa are in three complete cycles, regularly arranged. Those of the first cycle are thin, laminar, straight, extending nearly to the columella where they apparently terminate in pali. The second cycle is about two thirds as long as the first. The third cycle is very short, scarcely projecting into the calice. All the septa are thickened near the wall. Through the wall the septa are confluent with the septo-costae, which are well-defined on the surface and confluent between the calice. Beneath the surface, however, they lose their identity due to the highly developed synapticulae which are regularly spaced so that the intercorallite tissue has the character of a regularly reticulated coenenchyme. The columella is small, not prominent, styliform or compressed.

Holotype.—United States National Museum.

Occurrence: *Type locality.*—In the Devils River limestone (Kiamichi) at Painted Caves, Rio Grande River one mile below the mouth of Pecos River, Val Verde County, Texas. A specimen of what may be *Astrocoenia nidiformis* Cragin, which occurs in central Texas in the Comanche Peak formation, also comes from this locality.

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[124] Wells, J. W. Corals of the Trinity Group of the Comanchean of central Texas. **Jour. Paleont.**, vol. 6, no. 3, p. 253, pl. 31, fig. 8; pl. 32, fig. 4, 1932.

[125] Michelin, H. Icon. Zooph., p. 26, pl. 7, fig. 8, 1841.

[126] Ibid., p. 305, pl. 72, fig. 7.

Remarks.—The regular mesh-work of the inter-corallite tissue of this species is unusual in this genus and serves to distinguish it from other forms.

Actinacis reaches its greatest development in the Senonian.[127] The earliest forms recorded up to the present are *A. insignis* and *A. stellulata* Duncan[128] from the upper Greensand (Cenomanian) of Haldon, Devonshire. The present species extends the range of the genus below the Cenomanian into the middle Albian.

UPPER CRETACEOUS

Suborder APOROSA Milne Edwards & Haime

Family TURBINOLIIDÆ Milne Edwards & Haime (restr. Verrill)

Genus PLATYTROCHUS Milne Edwards & Haime 1848

Genotype.—*Turbinolia stokesi* Lea 1833. Claibornian. Alabama, etc. (By subsequent designation E. & H. 1850).

Notes on the genus.—The American Cretaceous and Tertiary species of *Platytrochus* may be divided into two well-marked groups, one, which includes the type species, having broad costae with several rows of granulations, and the other, including forms with more or less subacute costae with beaded or nearly simple margins. These may be called the *stokesi*-group and *claibornensis*-group, respectively, and are distinguished as follows:

I. Costae broad, *stokesi-group*:
  A. Costae always 24, costal interspaces wide *P. stokesi* (Lea)
  B. Costae may exceed 24, costal interspace narrower than preceding .... *P. goldfussi* (Lea)
II. Costae narrow, subacute, *claibornensis-group*:
  A. Costae 44 in numuber.
    1 Costae thick and rounded, granulations close .... *P. claibornensis* de Gregorio
    2. Costae thinner and subacute, granulations fine .... *P. vaughani* (Stephenson)

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[127] Oppenheim, P. Anthozoen der Gosauschichten, pp. 5-21, 1930.

[128] Duncan, P. M. On the upper Greensand fauna of Haldon, Devonshire. Quart. Jour. Geol. Soc. London, vol. 35, p. 93, pl. 8, figs. 7-8, 1879.

It will be seen that the distinctions between the species of the *claibornensis-group* are slight and it may be that the three species now known are descendants along one line, *P. vaughani,* which is the first species of the genus noted from the upper Cretaceous, being the ancestor of a Midwayan (lower Eocene) species described in manuscript by Vaughan and Popenoe which is in turn the predecessor or precursor of *P. claibornensis.*

The general appearance of *Flabellum ? merriami* Nomland[129] of the Eocene of California is that of a *Platytrochus,* but details of the structure are lacking. Vaughan and Hoffmeister[130] have referred Nomland's species to *Smilotrochus,* suggesting that what Nomland called a true columella is really a false one.

Platytrochus vaughani (Stephenson) Pl. 12, fig. 4; pl. 14, figs. 13-14

Trochocyathus ? vaughani Stephenson 1916. Maryland Geol. Survey, pp.

Stephenson's original description.—Corallum cuneiform, with no recognizable scar of attachment; viewed from the side it is subtriangular in outline and a little elongate in the direction of the height; cross-section lenticular with dull acute angles at the ends.

Theca well-developed. Corresponding to the septa are strong, subacute ribs with deep intercostal depressions; new ribs are intercalated as new septa are formed; on the sides bordering the acute edges are tuberculated broadcast below, narrowing to the serrated edge above.

Septa about 36, of which about 24 extend inward to the columella. The septa are in three or four cycles, but the different cycles cannot be differentiated. The members of the last cycle are very thin and frail. The inner edges of the principal septa are fused to the columella and to adjoining septa by trabecular-like processes. There is a suggestion of paliform lobes, though the upper edges of the septa are too imperfect to permit positive determination of this feature. Sides of septa set with small tubercles and spine-like processes, the arrangement of which cannot be clearly seen in the specimen.

There is doubt as to the mode of origin of the columella, but is appears to be spongy and trabecular.

Dimensions.—Longest transverse axis at top, about 5 mm.; shortest transverse axis, 2.5 mm.; height, 4.5 mm.

Holotype.—United States National Museum Accession No. 59132. Property of the Geological Survey of Maryland.

Occurrence: *Type locality.*—In the Monmouth formation, (*Exogyra* costata zone) in the bed of a small branch about seven-eighths of a mile south of west of Brightseat, Maryland, three-eighths of a mile south of the Sheriff road.

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[129] Nomland, J. O. Corals from the Cretaceous and Tertiary of California and Oregon. **Univ. of California Pub. Geology,** vol. 9, no. 5, p. 62, pl. 3, figs. 1-4, 17, 1916.

[130] Vaughan, T. W. and Hoffmeister, J. E. New species of fossil corals from the Dominican Republic. **Mus. Comp. Zool. Bull.,** vol. 67, no. 8. p. p. 316, 1925.

Remarks.—The holotype is somewhat broken but the structure is well shown. The columella is identical with that found in *P. stokesi,* a parietal axis, formed by the fusion of the lobes from the inner margins of the septa. There are no true pali· thus removing the species from the *Caryophylliidae.* The septa are apparently 44 in number, of which 36 belong to the first three cycles and alternate in size, the 18 larger and thicker ones forming the columella. On either side of the larger septa and two secondaries at the ends of the long axis of the corallum are intercalated two septa of the 4th cycle, a total of 8. It is very likely that the full number of septa is 48, the septal arrangement being irregular as in the Midwayan species and that the holotype represents an immature specimen.

Genus STERIPHONOTROCHUS Vaughan 1900

Genotype.—*Steriphonotrochus pulcher* Vaughan 1900. Lower Oligocene. Red Bluff beds, Mississippi. (By original designation).

Notes on the genus.—This genus is distinguished from other Turbinolid genera by the peculiar character of the inner upper margins of the septa, which are marked by several curly lobes, somewhat like pali. The upper margins near the wall are entire, and the pali-like lobes are perhaps analogous to the lobes found in *Dasmosmilia.*

Steriphonotrochus ? manorensis n. sp. Pl. 14, fig. 21

Description.—Corallum tall, elongate conical, slightly curved in shape, broken off base. Calice evidently elliptical, of moderate depth, with rounded margins. Wall thin, covered with regularly alternating, acute costae, entire below, faintly beaded near the calicular margin with smooth interspaces, 64 in number. The alteration of the costae is very pronounced and toward the base the smaller ones become almost obsolete. The septa are 64 in number, corresponding to the costae. Their upper edges are exsert and entire, but the inner part of the upper edges are marked by two or three broad curly lobes which occupy the inner half of the margin. The cyclical arrangement could not be determined, but appears to be irregular. Their sides are granular, and about half of them extend to the columella. The columella is spongy, composed of intertwined processes, not prominent in the calice.

Dimensions.—

	HEIGHT	CALICULAR DIAMETERS	DEPTH
(Holotype)	18 mm.	8 mm.x14.5 mm.	3.5 mm.

Holotype.—United States National Museum.

Occurrence: *Type locality.*— Fossiliferous calcareous clays of the middle (?) Navarro on a hillside by the road about 2.4 miles southeast of Manor, Travis County, Texas. (Collected by J. W. Wells).

Remarks.— The above is a description of the holotype, which is a crushed corallum in a fair state of preservation. The calice is badly damaged and I cannot be sure of the exact nature of the septal margins, but the presence of the paliform lobes is practically certain.

The species is easily recognized by the acute, alternate costae and relatively large number of septa.

COMPARISON OF THE SPECIES OF STERIPHONOTROCHUS

	S. pulcher V.[131]	*S. leithensis* V.[132]	*S. manorensis* n. sp.
Horizon	L. Oligiocene	Danian	Navarro
Height	28 mm.	13.5 mm.	18.0 m.
Diameters	13 x 17	9 x 8.5	8+ x 14.5
Septa	54	48	64
Costæ	Acute, alternating granulate	Obtuse, low, equal	Acute, alternating

Family CARYOPHYLLIIDÆ Dana (restr. Verrill)

Genus CARYOPHYLLIA Lamarck 1801

Genotype.— *Madrepora cyathus* Ellis and Solander 1786. Recent. Mediterranean.

Caryophyllia stephensoni n. sp. Pl. 12, figs. 6-7; pl. 14, figs. 15-18

Description.— Corallum conical, relatively tall, straight or slightly curved below, with a small basal attachment or free. Calice subcircular or slightly elliptical in outline, with a deep fossette. Wall solid, covered by well-developed, acute costae which are distinct to the base, alternating slightly in size, their edges beaded, the smooth interspaces between them shallow, broader than the costae. No traces of an epitheca. The septa are in four complete cycles, 48 in number, thick near the wall and nearly equal, becoming thin toward the columella, slightly exsert and faintly dentate on the upper margins, lightly granulated laterally. Those of the first and second cycles are equal and extend to the columella. The third cycle is slightly shorter and terminates in a crown of 12 pali. The fourth cycle is short and thin, sometimes incomplete in small individuals. The pali are small and thin. The columella is large, filling the bottom of the fossette, papillary on its upper surface and composed of 15 to 20 ascending rods or processes.

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[131] Vaughan, T. W. Eocene and lower Oligocene faunas of the United States with a few doubtfully Cretaceous species. **U. S. Geol. Survey Mon.** 39, p. 113, pl. 9, figs. 5-5d, 1900.

[132] Vaughan, T. W. Corals from the Cannonball marine member of the Lance formation. **U. S. Geol. Survey Prof. Paper** 128 A, p. 64, pl. 10, figs. 6-6b, 1920.

Dimensions.—

SPECIMEN	HEIGHT	CALICULAR DIAMETERS
1. (Type)	14.5 mm.	11.0 x 11.5 mm.
2. (Paratype)	16.5	13.0 x 13.5
3. "	17.0	13.0 x 13.5
4. "	14.0	10.0 x 10.5
5. "	11.0	9.5 x 10.0
6. "	11.5	9.5 x 10.0

Type and paratypes.— United States National Museum.

Occurrence: *Type locality.*— In the upper part of a chalky marl member of the Navarro formation, on a branch of Mustang Creek, above and below the Taylor-Noack road, a mile south of 70° west of Noack, three miles south of 30° west of Thrall, Williamson County, Texas. (U. S. G. S. Mes. Loc. 15537). (Collected by L. W. Stephenson, 1930).

Other localities.— (a) One specimen, an internal mold, is from the Navarro formation in a bluff on a small creek entering York Creek from the south 4 miles southeast of Zorn, Guadalupe County, Texas. (U. S. G. S. Mes. Loc. 10877). (b) In the Arkadelphia clay in a branch east of the road, half a mile north by west of Reed's Store, about 6 miles west of

Hope, Arkansas, (18 specimens, U. S. G. S. Mes. Loc. 12936). (c) In the Navarro formation in concretions in the road, three-quarters of a mile northeast of Chatfield, Navarro County, Texas. (U. S. G. S. Nes. Loc. 7572). (d) A doubtful specimen in a block containing *Micrabacia arkansasensis* from 1 mile southeast of Hearn, Arkansas. (U. S. N. M. No. 22664).

Remarks.—A number of specimens from the Arkadelphia clay of Arkansas are referred to this species. They are precisely like the type specimens in every respect excpt that they rarely possess more than 44 septa, whereas typical *C. stephensoni* has 48. I am not sure that this single difference is worth varietal distinction because typical specimens of *C. stephensoni* occasionally lack some of the septa of the 4th cycle.

There are many species of this important genus known from the upper Cretaceous. This species groups with those species having four complete cycles of septa, alternating, acute or subacute, beaded or granulated, costae. These are *C. compressa* Duncan[133], *C. indica* Duncan[134], both from the Maestrichtian of Sind, and *C. danica* Nielsen[135] from the Danian coral chalk of Faxe. The last species is distinguished by the costae which alternate in groups of 4 instead of 2. *C. indica* has a circular calice with subequal costae. *C. compressa* Duncan, as the name implies, is a small compressed form.

Caryophyllia mississippiensis n. sp. Pl. 14, figs. 19-20

Description.—Corallum free, conical, expanding rapidly from a narrow base. Calice elliptical in outline, or of moderate depth. Septa in four complete cycles, thin and lightly granulated. Those of the first two cycles are equal and extend nearly to the columella. The septa of the third cycle are equal in size to those of the first two and terminate inwardly in a single crown of 12 pali around the columella. The remaining septa, the fourth cycle, are thinner than the rest and often united to those of the third cycle. The pali are plate-like, long and thin. The columella is composed of twisted ribbons, papillose on the upper surface.

[133] Duncan, P. M. Foss. Cor. Sind. p. 17, pl. 7, figs. 1-4, 1880.

[134] Duncan, P. M. Ibid, pp. 17-18, pl. 1, figs. 5-7.

[135] Brünnich-Nielsen K. Zoantharia from Eenone and Paleocene deposits in Denmark and Skaane. **D. Kgl. Danske Vidensk. Selsk. Skrifter** (8), 5, 3, p. 122, pl. 2, figs. 19-20, 1922.

D'mensions.—

SPECIMEN	HEIGHT	CALICULAR DIAMETERS
1. (Type)	12 mm.	11 x 13 mm.
2. (Paratype)	12	11.5 x 13
3. (Homeotype)	10	9.5 x 10.5
4. "	11	12 x 12.5
5. "	9.5	10 x 13.5 (crushed)

Type, paratype, and homeotypes.—United States National Museum.

Occurrence: In the *E. costata* zone, below the *Liopistha protexta* subzone, of the Selma chalk, at the following localities:

Type locality.—Agricultural and Mechanical College campus, Starkville, Mississippi. (U. S. G. S. Mes. Loc. 3186). Collected by A. F. Crider.

Other localities.—(a) Macon-Shuqualak road, one half mile south of bridge over Running Water Creek, 5 miles south of Macon, Noxubee County, Mississippi. (U.S.G.S. Mes. Loc. 6839). 'Layer No. 3 of section". Collected by L. W. Stephenson. (b) Wakalak, Noxubee County, Mississippi. (U.S.G.S. Mes. Loc. 16242). Wetherby collection.

Remarks.—Although this species is founded on specimens which are only internal casts, I feel that it is sufficiently characterized so that it can be recognized when it is found in the future. It is unlikely that better specimens will be collected from the Selma chalk or that the exterior will be accurately known. The distinguishing features of the species are the four complete cycles of septa with 12 pali before the third cycle and the relatively short, broadly conical corallum. *C. stephensoni* of the Navarro of Texas and Arkansas is probably related to this form but has a relatively taller corallum and smaller pali.

This species occurs at the localities mentioned above with *Dasmosmilia reesidei* and may be distinguished by its lack of dissepiments, regularly arranged pali, and finer septa.

Genus TROCHOCYATHUS Milne Edwards & Haime 1848

Genotype.—*Turbinolia mitrata* Goldfuss 1826. Miocene. Tortone. (By subsequent designation, E. & H. 1850).

Synopsis of American Upper Cretaceous Species.—

I. Septa varying in number from 24 to 45.
  A. Corallum free, septa not more than 40 *T. egerius* (White)
  B. Corallum attached.
    1. Septa about 45 . . . . *T. ? neumani* Vaughan
    2. Septa 24 to 36 . . . . *T. woolmani* Vaughan
II. Septa in 4 complete cycles.
  A. Pali 18 in number, before 2nd and 3rd cycles
    . . . . *T. dakotaensis* Vaughan
  B. Pali 24 in number, before first three cycles:
    1. Corallum short, conical:
    a. Costae equal, thick, rounded, beaded
    . . . . *T. matleyi* Wells (MS.)
    b. Costae somewhat unequal, subacute
    . . . . *T. gardnerae* n. sp.
    2. Corallum subhemispherical ,septa 44 to 48
    . . . . *T. mississipiensis* n. sp.
III. Septa in more than 4 cycles, 50 to 72 in number
    . . . . *T. taylorensis* n. sp.

Distribution of species.—

T. ? neumani Vaughan	Lance formation	North Dakota
T. dakotaensis Vaughan	Lance formation	North Dakota
T. egerius (White)	Pierre and Lewis shales	Western Interior
T. matleyi Wells (MS.)	Maestrichtian	Jamaica
T. gardnerae n. sp.	Navarro formation	Texas
.*T. mississippiensis*. n. sp.	*E. ponderosa* Zone	Mississippi
T. woolmani Vaughan	Matawan marls; *E. cancellata* zone, Ripley and Taylor formations	New Jersey, Georgia and Texas

Trochocyathus egerius (White) Pl. 12, figs. 1-3; pl. 14, figs. 1-3

Caryophyllia egeria White 1879. U. S. Geol. Survey, Eleventh Ann. Rept. for 1877, p. 275, pl. 6, figs. 7a-7b.
Caryophyllia johannis White 1879. Ibid. p. 274, pl. 6, fig. 6.

Caryophyllia egeria Felix 1914. Fossilium Catalogus, pars 7, p. 251.
Caryophyllia johannis Felix 1914. Ibid. p. 210.

White's original description.— Corallum reversely conical; sides more or less convex, base rounded; calyx subcircular, shallow; the border apparently a little thickened and slightly projecting; septa about 30, each alternating one not reaching the columella, their sides marked vertically by small, slightly raised ridges, giving their edges a rugose appearance when broken across transversely; columella composed of loosely aggregated, irregular, coarse threads.

All the examples that were discovered are imbedded in rock, and none of them show the outer surface satisfactorily, but the epitheca seems to have been thin, and the vertical costae not prominent.

Height about 7 mm.; diameter of the calyx the same; but these proportions vary, some of the examples being proportionally shorter.

Additions to the foregoing description.—The form of the corallum is very variable in this species, depending on the relative age of the specimens. Thus, the younger forms are almost discoid, the base being but slightly convex. The convexity of the base increases with age and the walls may become almost vertical. In one specimen the corallum has become almost cylindrical. The figures give an idea of this variation.

The exterior does not appear to have been covered by an epitheca and is marked by acute, low, broad costae which have narrow beaded edges, and which correspond in size to the septa which they represent, those of the first two cycles being equal and largest, the remainder proportionately smaller. Towards the base they become obsolete in most specimens. The base is rounded and free from attachment. The wall is thick, formed by septal thickening. The septa vary in number from 24 to 40, the average number being between 32 and 36 in the larger specimens, the smaller, more discoidal specimens possessing as few as 24. They regularly alternate in size, although those of the first cycle are a little longer than the rest. Their upper edges are entire or minutely crenate, and exsert near the margin of the wall. Laterally they are covered by rounded granulations arranged in rows extending upwards and outwards from the walls. At their inner ends there are from 15 to 19 pali, placed before the larger septa of the first, second, and part of the third cycle. The pali are well-differentiated from the septa and stand as compressed columns attached to the inner ends of the septa by a few processes. Ocassionally a perforation or two exists near the inner ends of the septa and one or two synapticulae (?) may be developed, as in *T. lunulitiformis* (Conrad).[136] The septa of the fourth cycle are often fused to those of the third. The columella is composed of several rods fusing by cross processes, the upper surface being papillate.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETER OF CALICE	SEPTA
T. johannis (White) (f. White)	6 mm.	5 x 5.5 mm.	30-40
T. egerius (White)			
1. (Cotype)	?	7.5	28
2. ”	5	7.0	32
1. (Plesiotype)	3.0	6.1	36
2. ”	3.0	6.5	40
3. ”	3.5	6.5	39
4. ”	3.7	8.0	36
5. ”	4.3	7.3	32
6. Cotype)	4.5	7.5	32
7. ”	6.0	6.5	32
8. (Plesiotype)	6.5	6.0	40
Average	4.55	6.89	36

Cotypes and plesiotypes.—United States National Museum.

Occurrence: Type locality.—The cotypes of *C. egeria* are from the Pierre shale on Sage Creek, upper Yampa River, northwestern Colorado.

Other localities.—White's cotypes of *C. johannis* (=*T. egerius*) are from the Pierre shale near Cimarron, New Mexico.

The plesiotypes, of which there are a considerable number, are from the upper Pierre at the head of Dry Creek, northwest rim of the Black Hills, South Dakota. (U.S.G.S. Mes. Loc. 12700). (Collected by W. W. Rubey).

One cast of a specimen of this species is from the Lewis shale at a locality on the third creek west of Terrible Creek, a tributary of the Yampa River, northwestern Colorado. (U.S.G.S. Mes. Loc. 9584).

Remarks.—The type specimens of both *Caryophyllia egeria* and *Caryophyllia johannis* White are in the United States National Museum, (Nos. 8083 and 8084). There are five specimens of the former species, all cotypes, one of which is a fragment, and two of the latter, presumably cotypes, although they do not resemble Whtie's figure 6a, but the larger one is close to figure 6b. The smaller specimen is obviously a fragment of *C. egeria* and I am placing *C. johannis* in the synonymy of that species, for the reasons that White's figure 6d appears to represent a calice of *C. egeria* and that his smaller cotype surely belongs to that species, while the other cotype, from all that can be made out, is probably the same. No specimen corresponding to figure 6b can be found, and it appears to represent a distorted specimen of *C. egeria*.

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[136] Vaughan, T. W. Eocene and lower Oligocene faunas of the United States with a few doubtfully Cretaceous species. U. S. Geol. Survey Mon. 39, p. 95, 1900.

This species is referred to *Trochocyathus* because of the pali which are present before all but the last cycle, whereas in typical *Caryophyllia* they are absent before the first two cycles.

Trochocyathus woolmani Vaughan Pl. 14, figs. 4-7

Platytrochus speciosus Johnson 1898. New Jersey Geol. Survey Ann. Rept. for 1897, p. 265.

Platytrochus speciosus Johnson 1898. Phyladelphia Acad. Nat. Sci. Proc. p. 462.

Trochocyathus woolmani Vaughan 1900. Philadelphia Acad. Nat. Sci. Proc. pp. 436-437, figs. 1-3.

Trochocyathus woolmani Johnson 1905. Philadelphia Acad. Nat. Sci. Proc. p. 4.

Trochocyathus woolmani Weller 1907. New Jersey Geol. Survey, Pal. eont. vol. 4, p. 168, pl. 5, figs. 5-7.

non Platytrochus speciosus (Gabb & Horn) 1860. Philadelphia Acad. Nat. Sci. Jour. (2), vol. 4, p. 399, pl. 69, figs. 15-17.

Vaughan's description.— Corallum short, inversely conical, living attached, transverse outline circular.

Dimensions.— Diameter of calice, 3.5 mm.; altitude of corallum, 4 mm.; diameter of area of attachment, 1 mm. Wall rather thick, naked, ornamented externally by twenty-four costae, corresponding to all cycles of septa, and showing a fairly regular alternation of larger and smaller — *i.e.*, there are twelve larger costae of the same size corresponding to the septa of the first and second cycles, and twelve smaller corresponding to the septa of the third cycle. Near the calice they are prominent, with acute edges and broad bases; as the base of the corallum is approached they decrease in prominence. They possess granulations along their edges, and some scattered granulations on the sides.

There are three cycles of septa, divided into six systems. The members of the first cycle are appreciably larger than the other septa, and pass directly from the corallum wall to the columella space without forming part of any septal group. The members of the third cycle bend toward the members of the second, and fuse to the sides of the latter below the level of the calice. The septal margins project very slightly above the upper edge of the corallum wall. The septal faces are ornamented with distant subconical granulations.

The inner end of each of the primary septa is thickened, the thickening apparently representing a palus, and before each group of the members of the second and third cycles is what appears to be a slender palus;

therefore, there are apparently slender pali before the septa of the first and second cycles.

The columella is not large; it is fasciculate, with a papillary upper termination.

Type.—Academy of Natural Sciences of Philadelphia, No. 685.

Occurrence: *Type locality.*—Matawan clay marls, (Woodbury (?) clay), artesian well, Mt. Laurel, New Jersey, 150-160 feet below surface.

Other localities.—(a) Ripley formation, Chattahoochee River, just below Banks Landing, 27 miles below Columbus, Georgia. (U.S.G.S. Mes. Loc. 5390). (Collected by L. W. Stephenson). (b) Navarro formation, (*E. cancellata* Zone), Coriscana road, west-facing slope of Cedar Creek valley, two and one half miles north of Corbet, Navarro County, Texas. (U.S.G.S. Mes. Loc. 16170). (Collected by L. W. Stephenson). (c) Navarro formation, (*E. cancellata* Zone), three and one half miles west-northwest of courthouse at Corsicana, Navarro County, Texas. (U.S. G.S. Mes. Loc. 16166). (Collected by L. W. Stephenson).

Remarks.—This is a very small, but well-marked species. I have been unable to distinguish a number of specimens from the Ripley and Navarro formation of Georgia and Texas, from the New Jersey form, although those from Texas present some variations, mainly in the number of septa. The dimensions and number of septa of some of the Texas forms are:

SPECIMEN	HEIGHT	CALICES	NO. OF SEPTA
1.	5.5	[illegible].0 x 4.5 mm.	36
2.	5.0	4.5	26
3.	5.0	4.25	26
4.	4.0	3.0 x 3.5	30
5.	3.5	3.5	24

These specimens, like the types, are all attached, usually to small gastropods, and at first glance might be mistaken for *Paracyathus.*

The species is closely related to *T. egerius,* the main points of distinction being the attached base of *T. woolmani.* In *T. egerius,* the costae are more acute and spaced a little farther apart. In *T. woolmani,* the costae of which are covered by fine granulations, there is no tendency for the costae corresponding to the first two cycles to be larger than the remainder if there are more than three cycles of septa and their alternation is not so pronounced. *T. gardnerae* is a larger species and possesses more septa. Two specimens of this last species were also collected at locality 16170.

One specimen, an internal cast, was identified by Dr. Vaughan as *T. sp. aff. T. woolmani.* It was collected between 1230 and 1250 feet below the surface in the well of the Charleston Consolidated Railway and Lighting Company at Charleston, South Carolina. The horizon of this specimen is the Peedee formation, according to Stephenson.[137]

The presence of this species in Texas, Georgia, and South Carolina (?) in beds of Maestrichtian age and in New Jersey in beds of Coniacian age leads one to wonder if the horizon of Vaughan's types was correctly ascertained. If it was, this species has a considerable vertical range.

Trochocyathus taylorensis n. sp. **Pl. 14, figs. 11-12**

Description.—Corallum reversed subhemispherical or low conical, straight, free. Calice broad, circular or slightly elliptical, and shallow. The septa are numerous, 60 in the type specimen and a few more than 72 in another. In the smaller specimens there are rarely less than 50. They are unequal in size and strongly granulated laterally. Pali before the first three cycles and that part of the fourth cycle which is equal, or nearly so, to the first three, varying in number from 24 to 36. Columella large, loose, composed of a fascicular mass of twisted rods. No dissepiments. Wall and costae not preserved.

Dimensions.—

SPECIMEN	HEIGHT	CALICES	NO. OF SEPTA
1. (Type)	7.5 mm.	16 x 17 mm.	58
2. (Paratype)	14.0	17 x 21	72
3. "	6.0	15 x 16	62 ?
4. "	6.0	13 x 13.5	50

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—The type, paratypes 2 and 3, and 10 other specimens, are from the basal beds of the Taylor marl on Walnut Creek, six miles east of Austin, Texas, about 500 yards above the bridge on the Austin-Manor road, Travis County, Texas.

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[137] Stephenson, L. W. A deep well at Charleston, South Carolina. U. S. Geol. Survey Prof. Paper 90, p. 91, 1914.

Other locality.—Paratype 4 is from a zone of phosphatized fossils about 170 feet above the base of the Taylor marl in a road cut on a hill seven and one half miles east of Austin on the Austin-Manor road, Travis County, Texas.

Remarks.—This species is described from a series of 13 specimens, all of which are preserved as casts of the interior, the exterior having been destroyed. The only other species of *Trochocyathus* from the *Exogyra ponderosa* Zone is *T. mississippiensis,* a species which has a smaller corallum and fewer (44-48) septa.

Trochocyathus mississippiensis n. sp. Pl. 14, figs. 22-23

Description.—Corallum small, reversed subhemispherical or bowl-shaped, free, often slightly compressed. Calice deep, with narrow rounded margins, circular or elliptical in outline, the depth being from one third to two thirds of the total height of the corallum. Septa in four complete cycles and six regular systems. In the majority of specimens, however, the septa of the fourth cycle are usually lacking in one or two systems so that the number of septa varies from 44 to 48. The septa of the first two cycles are equal and extend nearly to the columella, where they terminate in rounded, small pali. The septa of the third cycle are nearly equal to those of the first two in thickness, but terminate in a crown of small pali just outside the first. The septa of the fourth cycle are much thinner and extend less than halfway to the columella. The septa are laminar in structure, thickened at the wall and thin near the columella, granular laterally and entire on their upper margins. The columella is composed of rod-like processes, closely interwoven and papillose on the upper surface. It occupies about one third of the diameter of the corallum. Exterior of the corallum not observed.

Dimensions.—

SPECIMEN	HEIGHT	DIAMETERS
1. (Paratype)	3.0 mm.	5.5 x 5.5 mm.
2. "	3.5	6.0 x 6.5
3. "	3.75	6.5 x 7.0
4. (Type)	4.0	6.5 x 7.25
5. (Paratype)	5.0	7.5 x 8.0
6. "	5.0	8.0 x 8.5

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—The type and 20 paratypes are from the *Exogyra ponderosa* Zone at the abandoned pit of the West Point Brick, Tile, and Lumber Company, on the northern outskirts of West Point, Mississippi. (U.S.G.S. Mes. Loc. 6883). (Collected by L. W. Stephenson).

Remarks.—All the specimens examined of this species are preserved as phosphatized internal casts, the exterior being destroyed in every case. However, the species is well charactrized and readily distinguished from the other species occurring in the Coastal Plain area. It appears to be analogous to *T. egerius* (White) of the Western Interior, having the same form and nearly the same size. In *T. egerius,* however, the total number of septa never exceeds 40, whereas in the present spcies there are never less than 44 in mature specimens. From *T. taylorensis* it is distinguished by its smaller size and fewer septa.

Trochocyathus gardnerae n. sp. Pl. 14, figs. 8-10

Description.— Corallum reversed-conical, expanding rapidly from a very small base of attachment or free. Calice shallow, broad, circular or slightly elliptical in outline, with a rounded margin. Wall thin, covered by acute, faintly beaded costae which are slightly unequal or alternating, corresponding to all the septa, with shallow intercostal grooves. Septa in four complete cycles, thin, slightly thickened at the wall, where they are a little exsert, laterally granulate with entire upper margins. Those of the first two cycles are equal and reach the columella. The third cycle is slightly shorter, and the fourth cycle is very short. The first three cycles terminate in thin, small, short pali. The columella is well-developed, but small, not prominent in the calice and composed of twisted processes.

Dimensions.—

SPECIMENS FROM TRAVIS COUNTY, TEXAS

SPECIMEN	HEIGHT	CALICES
1. (Type)	9.0 mm.	9.5 x 14.0 x 2.5 mm.
2. (Paratype)	7.5	10.0 x 10.5 x 1.5
3. "	7.0	8.5 x 9.5 x 1.5
4. "	4.5	5.0 x 5.5 x 1.0

SPECIMENS FROM NAVARRO COUNTY, TEXAS

SPECIMEN	HEIGHT	CALICES
1.	9.5 mm.	*ca.* 9 mm.
2.	8.5	9 x 10
3.	*ca.* 7.0	*ca.* 7

Type.— United States National Museum.

Paratypes.— Texas Christian University, Ft. Worth, Texas.

Occurrence: *Type locality.*— In the Navarro formation on Onion Creek, first bluff above Jones' Crossing, 45 feet above water level, Travis County, Texas.

Other localities.— (a) In calcareous concretions in the upper Navarro formation five and one-half miles southwest of Currie, Navarro County, Texas. (U. S. G. S. Mes. Loc. No. 14139). (b) In the Navarro formation in a creek one quarter mile north of Corsicana, Navarro County, Texas. (U. S. G. S. Mes. Loc. No. 518). (c) Navarro formation, two and one-half miles north of Corbet, Navarro County, Texas. (U. S. G. S. Mes. Loc. No. 16170). (Collected by L. W. Stephenson).

Remarks.— This species seems to be close to *T. mississippiensis* and is also similar to *T. egerius* of the Western Interior. The specimens from Navarro County are the only ones which show well the character of the costae, which are very similar to those of *T. egerius*. *T. egerius*, however, is a much smaller species and rarely if ever has more than 40 septa. *T. mississippiensis* is founded on specimens found as internal casts so that the costal characters cannot be compared. It has a smaller and more hemispherical form with a deeper calice in proportion to its height.

Genus PARACYATHUS Milne Edwards & Haime 1848

Genotype.— *Paracyathus procumbens* E. & H. 1848. Mid Eocene. France. (By subsequent designation, E. & H. 1850).

Paracyathus ? vaughani Weller

Paracyathus ? vaughani Weller 1907. Cret. Paleont. New Jersey, pp. 270-271, pl. 5, figs. 11-13.

Weller's original description.— Corallum subcylindrical in form, with a broad spreading base so that the diameter of the basal disc by which it is attached is as great or greater than the thickest portion of the corallum above; immediately above the base the outer wall contracts somewhat abruptly for a short distance, and then increases gradually in diameter to the summit. The calice is very deep, reaching almost to the base of the corallum. The outer surface of the theca is marked by about 40 longitudinal, finely denticulate costae, which continue across the expanded basal portion. The characters of the septa are not clearly shown in the type specimen, but they are apparently of the same number as the external costae.

The dimensions of the type specimen are: diameter of corallum at base, 10 mm.; minimum diameter of corallum, 5.5 mm.; diameter of corallum at summit, 8 mm.; height of corallum, 14.5 mm.

Occurrence: *Type locality*.— In the Navesink marl, Mullica Hill, New Jersey.

Remarks.— This species was founded on a single specimen in the form of a mold of the exterior. The reference to *Paracyathus* is exceedingly doubtful, although the species is brobably some Caryophyllid.

Family TROCHOSMILIIDAE Pourtalès

Genus TROCHOSMILIA Milne Edwards & Haime 1848

Genotype.— *Turbinolia corniculum* Michelin 1846. Eocene. France. (Genelectotype, Gregory, 1900).

Trochosmilia moorei n. sp. Pl. 14, fig. 30

Description.— Corallum cornute, more or less elongate and subcylindrical, somewhat compressed, attached by a small base, above which it expands rapidly with occasional constrictions. Wall solid, devoid of an epitheca, marked by regularly alternating, acute, faintly beaded costae, which are separated by rounded shallow interspaces and distinct to the base. Calice oval or compressed in outline, deep, with a subacute margin. Septa numerous, 72 in the type specimen, but fewer in the paratypes, which are smaller. They are unequal, and thin, laterally granulate, irregularly arranged, from 12 to 18 extending nearly to the center of the calice. The septa of the higher cycles appear to unite with those of lower cycles. Columella absent. Endothecal dissepiments well-developed, forming a zone around the periphery of the corallum within the wall which may be as much as 1.5 mm. in width in the lower parts of the corallum.

Dimensions.—

SPECIMEN	HEIGHT	CALICE
1. (Type)	15.0 mm.	3.0 x 9.0 x 4.0 mm. (crushed)
2. (Paratype)	16.5	6.5 x 11.0 x 4.5
3. "	13.0	5.0 x 11.0 x 3.75 (?) (crushed)
4. "	8.0	6.0 x 9.5 x 2.5 (?)

Type and paratypes.— United States National Museum.

Occurrence: *Type locality.*—In the basal part of the Mancos shale, (Tropic shale), 100 feet above the base, three miles north of Henrieville, Garfield County, Utah. (U. S. G. S. Mes. Loc. 13108). (Collected by R. C. Moore, 1921).

Remarks.— There are 9 specimens of this species in the National Museum. All of them are badly preserved and none shows the normal form of characters of the corallum well. The endothecal tissue in them has been filled by calcite, usually obliterating its structure so that the specimens appear to be Turbinolids with an unusually thick wall. As a rule the calices are crushed so that the septal ends are intermingled in the center giving the appearance of a columella, which is really absent, as are also pali.

The type is a corallum which has become constricted near the calice so that the greatest diameter (6.5 x 10 mm.) occurs at a point 6.5 mm. above the base.

This species is marked by the relatively small number of septa for the species of this genus, and by the alternating beaded costae. It is also unusually small for the genus. Compared with *T. stainbrooki* of the lower Cretaceous, it is smaller, with fewer septa, and has more prominent, alternating costae, but it belongs to the same species group, that of *T. inflexa*.

In a recent paper[138] this species is referred to as "*Trochocyathus* or*Paracyathus* n. sp."

Genus DASMOSMILIA Pourtalès 1880

Genotype.— *Parasmilia lymani* Pourtalès 1871. Recent. Off Grenada, West Indies. (Genelectotype Wells, 1933).

Notes on the genus.— This genus was founded by Pourtalès[139] for his species *Parasmilia lymani* and *P. variegata*, which he considered abnormal forms differing from *Parasmilia* by the presence of a rudimentary epitheca, false columella, and false pali, formed by the inner ends of the septa. Endotheca is present, but is very sparse and thin. The examination of a number of specimens of *P. lymani* in the National Museum convinces me that the genus is distinct and because Pourtalès says in his generic description "the figure of one of the septa of *P. lymani* in my 'Deep-Sea Corals,' Pl. VI, fig. 10, represents well the principal generic character", I select it as the genelectotype.

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[138] Gregory, H. E. and Moore, R. C. The Kaiparowits region. A geographic and geologic reconnaissance of parts of Utah and Navada. **U. S. Geol. Survey Prof. Paper 164**, p. 100, 1931.

[139] Pourtalès, L. F. Report on the results of dredging, ... in the Caribbean Sea, 1870-79, by the .... "Blake", ... III. Report of the corals and Antipatharia. **Mus. Comp. Zool. Bull.**, vol. 6, no. 4, 108, 1880.

The species described below is very much like *Coelosmilia* but there are important differences: the presence of a false but well-defined columella, the paliform lacerations on the inner edges of the septa, and the remains of an epitheca are all distinct from that genus. *Dasmosmilia* is the only genus which possesses these characters. The present species is a much heavier form than the recent species of the West Indies, the septa and walls are much thickened below the calice and there is some filling up of the lower part of the corallum.

Dasmosmilia reesidei n. sp. Pl. 12, figs. 8-9; pl. 14, figs. 25-29

Description.— Corallum simple, turbinate or cornute, straight, or curved near the base, free in the adult stages, the base being marked by a small scar of attachment. Calice subcircular, relatively shallow with narrow rounded margins. Wall thin, with regularly alternating, subacute, costae, which are finely granulated. A few shreds of a thin, loosely-applied epitheca remain. Septa laminar, slightly exsert, alternately thick and thin and unequal in length, finely granulated laterally, varying in number from 60 to 100 (in the specimens examined). The inner ends of the larger ones are prolonged, in the lower parts of the corallum, towards the center where they intermingle and unite irregularly. In this region they are considerably thicker than in the upper part of the calice. Their inner ends are marked by thin, long, curled paliform lobes at the junction of several septa. In the basal portion of the corallum the endotheca is well-developed and often forms a nearly solid deposit in the lowest parts. It is very scanty in the calicular region.

Dimensions.—

SPECIMEN	HEIGHT	CALICES	NO OF SEPTA
1. (Type)	15.5 mm.	16.5 x 18.5 mm.	72
2. (Paratype)	17.0	20.0 x 21.0	98
3. (Ideotype)	20.0	16.5 x 20.0	*ca.* 80

4.	"	14.5	15.0 x 17.0	*ca.* 100
5.	"	23.0	18.0 x 20.0	72

Types, paratypes, and ideotypes.— United States National Museum.

Occurrence: *Type locality.*— The type and paratype are from the Navarro formation at the west facing bluff of Guadalupe river, one and one-third miles north of McQueeney, Guadalupe County, Texas. (U. S. G. S. Mes. Loc. 15524).

Other localities.— (a) Ideotypes 3 and 4 came from the Oktibbeha tongue of the Selma chalk at Agricultural and Mechanical College near Starkville, Oktibbeha County, Mississippi. (U. S. G. S. Mes. Loc. 6843.) ; (b) Ideotypes 5 and 6 are from the *Liopistha protexa* Subzone of the Selma chalk at Prairie Bluff, Wilcox County, Alabama. (U. S. G. S. Mes. Loc. 270.) ; (c) In the *E. costata* Zone below the *L. protexta* Subzone, on the Macon-Shuqualak road one-half mile south of bridge over Running Water Creek, Noxubee County, Mississippi. (U. S. G. S. Mes. Loc. 6839). Collected by L. W. Stephenson.

Remarks.— The type and paratype 2 are in good condition and the entire corallum is preserved, although the calices are filled with a tough matrix. The specimens from Mississippi are preserved as internal casts, but the septal structure is well preserved.

Genus PARASMILIA Milne Edwards & Haime 1848 (pars)

Genotype.—*Madrepora centralis* Mantell 1828. Senonian, England. (By subsequent designation, E. & H., 1850).

Parasmilia ? balanophylloides Bölsche

Parasmilia balanophylloides Bölsche 1870. Zeitschr. deutsch. geol. Ges., vol. 22, p. 215.

Bölsche's original description (*translated*).— Corallum nearly cylindrical and attached by a very broad base. Nearly equal costae, visible from the base, rounded and finely beaded. Calice circular. Columella papillose, not very large. Four cycles of thick, compact septa are completely developed in six systems (in 2 mm. 6-7 can be counted). The septa of the first and second cycles reach straight to the columella. The septa of the first cycle remain free; the other cycles are united symmetrically by their inner ends in all the systems; the septa of the third cycle are united with the second not far from the columella. Those of the fourth cycle forming the fourth and fifth orders bend so as to reach the third cycle and unite with it equally in the middle between the center and the wall of the calice. Sides of the septa strongly granulated; the tubercles are often so strongly developed that they are united with those of neighboring septa and in this manner form false synapticulae. Dissepiments rare. Diameter of calice 5 mm.; height of corallum 5 mm.

Occurrence: *Type locality.*— In the Marshalltown clay at Woodbury, New Jersey.

Remarks.— According to Bölsche this species is very common and grew attached to broken fragments of *Gervillia solenoides,* but it has not been reported by later authors. If his description is correct, this is not a *Parasmilia* but some form of the *Eupsammiidae,* perhaps *Wadeopsammia* or *Balanophyllia.* There is also the possibility that it may be a *Trochocyathus woolmani* with four complete cycles of septa. Until the types can be examined or new specimens found, the species remains doubtful.

Family OCULINIDAE Milne Edwards & Haime

Genus ARCHOHELIA Vaughan 1919

Genotype.— *Archohelia limonensis* Vaughan 1919. Pliocene. Costa Rica. (By original designation).

Archohelia dartoni, n. sp. Pl. 12, figs. 11, 12; pl. 14, figs. 31-35

Description.— Corallum ramose, forming fasciculate columns. Individual branches small, round, with a persistent axial corallite. Calices circular, slightly or considerably projecting, arranged in ascending spirals around the branches. Their diameter varies from 1.0 to 1.75 mm., the usual diameter being 1.25 mm. Their depth is less than half the diameter, the calicular margins are usually parallel to the surface of the branch, although those which are projecting are inclined toward the tip of the branch. The distance between adjacent calicular margins varies from 2.0 to 4.0 mm. The calicular margins are acute or subacute, marked by low rounded costae which usually disappear on the coenenchymatal surface. The diameter or cavity of the axial corallite averages 2.0 mm., about one-third the riameter of the branch. The coenenchyme is dense and its surface is faintly granulated. The septa are in three complete cycles, granulated or spinulose laterally, lightly denticulate on their upper margins. Those of the first and second cycles are nearly equal and their inner ends are terminated by small thin pali which form a double crown around the columella. The pali of the first cycle are larger and nearer the columella than those of the second cycle. The third cycle of septa is short. The columella is trabecular, formed by two or three small papillae. Endothecal dissepiments are sparse.

Dimensions.—

SPECIMEN	BRANCHES:			CALICES
	LENGTH	LOWER & UPPER ENDS		
1. (Type)	15 mm.	4.5 mm.	4.0 mm.	1.0 mm.
2. (Paratype)	19	4.5	4.5	1.3
3. “	26	5.5	5.0	1.7
4. ‘	28	5.0	4.5	1.2 - 1.5
5. “	14	4.0	3.0	1.3
6. “	22	8.5	7.0	1.2 - 1.5
7. “	22	6.0	5.0	1.2 - 1.5

Type and paratypes.— United States National Museum.

Occurrence: *Type locality.*— Carlile Zone of the Mancos shale at Laney, New Mexico. (U. S. G. S. Mes. Loc. 8817). (Collected by N. H. Darton, 1914).

Remarks.— In some of the branches the coenenchyme between the calices is raised in the form of a low narrow ridge, the calices occupying the centers of the low depressions between the ridges which have an hexagonal arrangement.

This species is unique in that it is the first of this genus to be made known from the upper Cretaceous. I have previously described in this paper a species from the Edwards limestone of the lower Cretaceous of Texas, but that form is not related to the present one whose nearest relatives are the Tertiary species described by Vaughan[140] from the Gulf coast and Caribbean region.

Family ORBICELLIDAE Vaughan

Genus HINDESASTRAEA White 1888

Genotype.— *Hindesastraea discoidea* White 1888. Navarro formation. Texas. (By monotypy).

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[140] Vaughan, T. W. The Eocene and lower Oligocene coral faunas of the United States ....U. S. Geol. Survey Mon. 39, pp. 116-124, pls. 10-12. 1900.

Fossil corals from central America, Cuba, and Porto Rico, ... U. S. Nat. Mus. Bull. 103, pp. 352-354, pl. 80, figs. 1-3, 1919.

Note on the genus.— This genus is difficult to place in a family. The main characters, however, are those of the *Orbicellidae* and it is associated with that group for the present.

Hindesastraea discoidea White

Hindesastraea discoidea White 1888. Geol. Mag. (3), 5, p. 363, figs. 5-7.
Hindesastraea discoidea Adkins 1928. Univ. of Texas, Bull. 2838, p. 75.
Hindesastraea discoidea Hoffmeister 1929. U. S. Nat. Mus. Proc. 76, Art. 23, p. 1, pl. 2, figs. 1-1a.

White's original description.— Corallum irregularly discoid or much depressed, attached by the apex of the original corallite, or free; corallites few, very short but moderately broad; the walls of the adjacent corallites usually in contact or fused together, when the border is polygonal; but they sometimes have a tendency to separate, when the border is subcircular; calices slightly concave or nearly flat; their borders more or less prominent and clearly defined; radiating septa prominent, 22 to 26, usually 24, in number; those of the first cycle four to six in number, reaching nearly or quite to the center of the corallite, where they are more or less centered. Those of the second cycle do not usually terminate interiorly by free ends, but are there joined to one another or to those of the first cycle. Those of the third cycle usually terminate like those of the second, but are sometimes free at the inner end; the sides and free edges of the septa subspinulose or tuberculose. The number of corallites in a corallum varies from one to seven or eight, their gemmation taking place at the margin of the calice, and usually after the original corallite has attained considerable size.

Diameter of the largest calice observed, 8 millimeters.

Types.— U. S. N. M. No. 19166.

Occurrence: *Type locality.*— Navarro formation near Terrell, Kaufman County, Texas.

Hindesastraea collinensis Hoffmeister

Hindesastraea collinensis Hoffmeister 1929. U. S. Nat. Mus. Proc., vol. 76, Art. 23, pp. 1-3, pls. 1-2 (except pl. 2, figs. 1, 1a).

Type and paratypes.— U. S. N. M. Nos. 73608, 73609.

Occurrence: *Type locality.*— Wolfe City sand member of the Taylor formation about one mile N.30 W. of Farmersville, Collin County, Texas. (U. S. G. S. Mes. Loc. 13781, 13837).

Remarks.— This species and the preceding one have been discussed by Hoffmeister, who separated the second one from White's on the basis of the defference in growth forms. *H. discoidea* is low and discoidal, *H. collinensis* massive and irregular. As Hoffmeister notes, the first species may represent the immature corallum (White's specimens rangs from a single corallite to more complete colonies) and the second the later development.

Suborder FUNGIDA Dana

Family AGARICIIDAE Verrill

Genus SIDERASTREA de Blainville 1830

Genotype.— *Madrepora radians* Pallas 1766. Recent. West Indies. (By subsequent designation, E. & H., 1850).

Siderastrea cretacea (Bölsche) Pl. 12, fig. 13; pl. 15, fig. 26

Astraea cretacea Bölsche 1870. Zeitschr. deutsch. geol. Ges., vol. 22, p. 216.

non Siderastraea cretacea Söhle 1897. Geogn. Jahreshefte vol. 9.

Bölsche's original description (translated).— The small hemispherical corallum composed of smaller individuals is attached by a broad base. The younger calices appear by extracalicular budding between the walls of the older ones; the polygonal calices, 4 to 5 mm. in diameter, are united by sharp, well-defined walls. Calices deep. Columella fairly well developed, spongy, with a papillose upper surface. Three cycles of septa, non-exsert, arranged in six systems (in a space of 2 mm. there are 3 - 4). The septa of the first and second cycles are equal, those of the third, not extending to the columella, unite by their inner ends to the septa of the second cycle. The thin septa are thickly covered with granulations which are more or less arranged in rows. In many calices the tubercules of the same sides are so developed in the region of the wall and the columella that the thickened septa are united and spongy in appearance. Dissepiments thin, not rare.

Occurrence: *Type locality.*—Plastic clay (Marshalltown clay ?) at Woodbury and Haddonfield, New Jersey.

Other locality.—Probably lowest Navarro formation, 10 miles north of Cameron on road to Burlington, Milam County, Texas. (U. S. G. S. Mes. Loc. 13864). (Collected by C. H. Dane).

Remarks.—No specimens of this species from New Jersey have been seen by the author, but Bölsche's description is good and the reference to *Siderastrea* probably correct.

To this species I am referring a specimen from the lowest Navarro on Milam County, Texas. It consists of two small and three very small colonies attached to a fragment of an oyster shell. The corallum of this form is encrusting; the calices measure from 3 to 5 mm. in diameter; the septa are in three complete cycles, arranged as indicated in Bölsche's description. The structure is typical of *Siderastrea* but the specimen is not as well preserved as one could wish.

Suborder PERFORATA Milne Edwards & Haime

Family EUPSAMMIIDAE Milne Edwards & Haime (restr.)

Diagnosis of the family.—Perforate madreporaria with simple corallum, laminar septa, and costae corresponding to the septa.

Type genus.—*Eupsammia* Milne Edwards & Haime 1848. Eocene-Recent.

Remarks.—I believe that the *Eupsammiidae* of Milne Edwards & Haime is too comprehensive and therefore restrict it to simple forms, splitting off two families, the *Micrabaciidae* of Vaughan, and the *Dendrophylliidae,* a new family. These three families are differentiated as follows:

I. Corallum simple:
  a. Costae corresponding to the septa, ... *Eupsammiidae*
  b. Costae corresponding to the intercostal spaces . . . . *Micrabaciidae*
II. Corallum colonial . . . . *Dendrophylliidae*

Genus WADEOPSAMMIA n. gen.

Genholotype.—*Trochosmilia nodosa* Wade 1926. Ripley formation. Tennessee.

Diagnosis of the genus.—Corallum simple, subconical, curved, with a small or slightly expanded base which may be occupied by a small tubular cavity. Wall thin, cellular, composed of a porus tangle of synapticulae and disconnected distal portion of the septa. Exterior devoid of an epitheca, covered with small rounded granules which are scattered toward the base but arranged in rows forming costae near the calice. Between the costae are rows of small pores in the corallite walls, which are usually filled near the base of the corallum. The upper edges of the septa are beaded or dentate and laterally they are covered by long granulations. In structure they are laminar and imperforate. The columella is large and solid, but not styliform, consisting of the inner ends of the septa cemented together by a solid deposit, the upper surface broad and nearly flat, covered by radiating rows of low nodules corresponding to the principal septa. Dissepiments absent.

Remarks.—This genus is founded to receive a species of small Eupsammid from the upper Cretaceous which is distinguished from other members of the family by its large, solid columella. Other genera of the family have the columella varying from rudimentary to spongy; none has a solid one. It is also distinguished by its apparent commensalism with a sipunculid worm, evidenced by the tubular cavity in the base, a feature which it shares with *Heteropsammia* E. & H. and *Stephanoseris* Verrill[141]. These two genera are separated from the present one by the broad base often larger than the corallum proper, and the tendency towards multiplication of the calices in the former, and by the distinct costae and perforate septa of the latter. Both genera are recent types.

The *Eupsammiidae* is essentially a Tertiary and Recent family, its first appearance being in the late Cretaceous, with a great increase of genera coming in the Eocene. *Wadeopsammia* appears, next to *Areopsammia* Dietrich, as the oldest representative of the family known at present. Its characters, however, although they do not represent a high stage of development, are less primitive than those of *Paleopsammia* Wanner or *Dungulia* Oppenheim, genera in which the septa are little united, the columella rudimentary or absent, and the wall perforate but not as highly porous and complex as in the Tertiary and Recent forms. *Areopsammia*[142] is a low, bowl-shaped form with nearly 5 complete cycles of septa and a poorly developed columella.

Wadeopsammia nodosa (Wade) **Pl. 12, figs. 14-15; pl. 15, figs. 23-25**

Trochosmilia nodosa Wade. 1926. U. S. Geol. Survey Prof. Paper 137, p. 26, pl. 1, figs. 1, 2, 5.

Wade's original description.— Corallum conical, base nearly flat, slightly concave, upper surface a low, slightly curved cone with a rough noncostate central plate about one-third the width of the base. Primary costae, or those extending from the outer margin to the central plate, number 12, secondary costae of two cycles and somewhat irregular in their occurrence and length; total of all three cycles of costae, 32. Intercostal spaces wider than the costae; septal faces granular or tuberculate, tubercles interlocking septa near center; inner character unknown; outer or upper surface of the cone nodose or perforated. Diameter 3.5 mm.; elevation, 3 mm.

Additions to Wade's description.—It will be seen that in this description the author has confused the base of the corallum with the calice, and the septa with the costae. The following is a revised description:

Corallum simple, cornute, with a small base enclosing a tubular cavity, evidently the burrow of a sipunculid worm. Calice circular, superficial. Wall thin, perforate, filling up solidly below. Costae mostly indistinct, represented by large nodules or tubercles which are arranged in definite rows near the calicular margin. Septa probably in four complete cycles (48) in adult specimens. Those of the first cycle are free and extend to the columella. The second cycle also extends to the columella and is joined by the third. The fourth cycle is regularly fused to the third not far from the wall. In structure the septa are laminar, with strongly-developed lateral spines and dentate on the upper margins which are slightly exsert. The columella is solid and large, composed of the inner ends of the septa cemented together in a solid mass. Its upper surface is level and depressed slightly below the calicular margin and is marked by radiating lines of nodules corresponding to the septa. There are no central tubercles. Synapticulae poorly developed, mostly near the wall. No epitheca.

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[141] This condition, however, is not taken as a positive generic character.

[142] Dietrich, W. O. Areopsammia, eine neue eupsammide Koralle aus der obersten Kreide. **Sitz. Ges. Naturf. Freunde Berlin**, p. 307, 1917.

Dimensions.—

	HEIGHT	CALICE	COLUMELLA DIAMETER	NO. OF SEPTA
1. (Type)	3.1 mm.	3 mm.	1.0 mm.	36
2. (Homeotype)	6.5	7	2.0	48

Type and homeotype.—United States National Museum.

Occurrence: *Type locality.*—Ripley formation on Coon Creek, McNairy County, Tennessee. (U. S. N. M. No. 32703).

Other locality.—Upper part of a chalky marl member of the Navarro formation, on a branch of Mustang Creek, above and below the Taylor-Noack road, Williamson County, Texas. (U. S. G. S. Mes. Loc. 15537).

Remarks.—This species is represented by two specimens from widely separated localities. The type of Wade's species is a small, well-preserved specimen from the famous Coon Creek locality which shows well the wall, septa, and columella, but it is evidently an immature individual, with only 36 septa, arranged as shown in the figure on Plate 12. The other specimen, from the Navarro formation of Texas, is larger and not as well-preserved, but shows 48 septa.

Family MICRABACIIDAE Vaughan, emend.

The families Micrabaciidae Vaughan and Antilloseridae, n. fam.— The systematic position of the genus *Micrabacia* E. & H. has been considered in some detail by Duncan,[143] who came to the same erroneous conclusion as other authors, namely, that *Micrabacia* belongs to the *Fungida.* More recently, Yabe and Eguchi[144] have made the same error and placed the genus in the *Fungiidae.* Vaughan[145] made the genus the type of his fungid family, the *Micrabaciidae.* Although *Micrabacia* has some characteristics of the fungids, one particularly distinguishes it, that is. the position of the costae in the intercostal spaces, rather than corresponding to the septa. The costae are not the prolongations of the septa beyond the wall, as in the fungids; they are formed by the fusion of two sets of synapticulae projecting downwards and inwards from the lower margins of the septa, exactly as in *Stephanophyllia* Michelin, *Leptopenus* Moseley, and *Diafungia* Duncan. That Duncan did not consider this peculiarity of the costae of more than specific importance is shown by his placing in the genus *Micrabacia* a species from the Gault of Folkstone, *M. fittoni,*[146] which has costae corresponding to the septa. Later, however, he suspected that his reference of the species to *Micrabacia* might be doubtful,[147] but he was unable to locate the holotype of *M. fittoni.* In passing, it may be noted that Tomes[148] believed ***M. fittoni*** to be a young or immature specimen of *Cyclocythus fittoni,* a Caryophyllid, an opinion which Duncan did not accept.[149]

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[143] Duncan, P. M. On the Internal structures and Classificatory Position of Micrabacia coronula (Goldf.) **Quart. Jour. Geol. Soc. London,** vol. 40, pp. 561-566. 1884.

[144] Yabe, H. & Eguchi, M. Some Recent and Fossil Corals of the Genus Stephanophyllia H. Michelin from Japan. **Sci. Rep. Tohôku Imp. Univ.,** ser. 2, Geol., 15, no. 2, p. 56. 1932.

[145] Vaughan, T. W. A Critical Review of the Literature of the Simple Genera of the Madreoporia Fungida with a Tentative Classification. **U. S. Nat. Mus. Proc.,** vol. 28, p. 386, 1905.

[146] Duncan, P. M. Suppliment to the British Fossil Corals. **Pal. Soc. London,** pt. 2, p. 37, pl. 14, figs. 6-9. 1869.

[147] Duncan, P. M. C. J. G. S. London, vol. 40, p. 565. 1884.

The wall and costal structure of *Micrabacia* and *Stephanophyllia* are identical in their development. This is a feature of particular importance. The peculiar costae of these genera are unlike both fungids and Eupsammids, but the other structures are similar to the latter. *Micrabacia* possesses the same septal arrangement as *Eupsammia* and *Stephanophyllia,* except for the slight modification found in the former. This arrangement, however, is not unique for the group but is also found in several simple genera of the *Fungida,* (*Fungia, Paracyclolites, Paracycloseris*) and in the *Turbinoliidae* (*Deltocyathus*).

Micrabacia and *Diafungia* have imperforate septa with prominent lateral granulations. In *Leptopenus* the septa are very thin and fragil but imperforate. In *Stephanophyllia* the septa are imperforate except for those of the highest cycles, at least in the case of the recent *S. formosissima* Mosely.[150] In the type species, *S. elegans* (Bronn) (U. S. N. M. No. 156350), and *S. imperialis* Michelin (U. S. N. M. No. 156365), of the European Miocene and Pliocene, the septa are wholly imperforate and laterally marked by low ridges or granulations. The dentations of the septa on these three species are relatively fewer, narrower, and higher, than in *Micrabacia.* The columella in both genera is precisely the same in structure. The grouping of the septa is the same, but the tendency of the groups of septa lying between the primaries to form a deltoid mass is more marked in *Stephanophyllia.* The characters of the four genera of the *Micrabaciidae* are summarized in the table:

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[148] Tomes, R. Observations on some imperfectly known Madreporia from the Cretaceous formation of England. **Geol. Mag.** (3), 2, p. 544. 1885.

[149] Duncan, P. M. An answer to "Observations on some .... Madreporia from the Cretaceous . . . of England." **Geol. Mag.** (3), 3, p. 52, 1886.

[150] Moseley, H. N. On the Deep-sea Madreporia. Challenger Reports, Zoology, vol. 2, pt. 7, p. 201, pl. 4, fig. 11; pl. 13, figs. 6, 7; pl. 16, figs. 8, 9. 1881.

	S. elegans	*M. coronula*	*L. discus*	*D. granulata*
Form	Plano-convex	Plano-convex	Plano-convex	Plano-convex
Wall	Perforate	Perforate	Perforate	Perforate
Costae	Corresponding to intercostal spaces	Corresponding to intercostal spaces	Corresponding to intercostal spaces	Corresponding to intercostal spaces
Septa	Imperforate; uniting; Deltas prominent	Imperforate; uniting; Deltas not prominent	Imperforate; uniting; Deltas prominent	Deltas present, not prominent
Septal teeth	Distant; tall	Close; short; transverse	Spiniform; very tall	Close; short
Columella	Trabecular	Trabecular	Trabecular	Absent (?)

From the table it is seen that the distinction between *Stephanophyllia* and *Micrabacia* is slight indeed. If the two genera are to be retained *Stephanophyllia* should be limited to those forms which possess prominent, but relatively distant, septal teeth and some perforate septa, and *Micrabacia* to those with low, closely-set teeth and imperforate septa, because these structures seem to possess the only important differentiating criteria.

It is necessary to exclude from the *Micrabaciidae* those genera in which the costae are continuous with the septa, e.g., *Antilloseris* Vaughan, *Microsmilia* Koby, *Vaughanoseris* Wells (M.S.), and *Podoseris* Duncan. These are typical fungid corals and merit a family position close to the *Fungiidae*. This family has been previously defined in this paper as the *Antilloseridae*. *Stephanophyllia*,[151] *Leptopenus*, *Micrabacia*, and *Diafungia*[152] are associated in the emended family *Micrabaciidae*.

Diagnosis of the family.— Simple, usually planoconvex or discoidal, perforate corals, with a perforate, synapticulate wall, on which the costae correspond to the intercostal spaces.

Synopsis of the genera.—

I. Septal dentations distant and tall ......
...... *Stephanophyllia* Michelin

II. Septal dentations close, short, and transverse.
  A. Columella absent .... *Diafungia* Duncan
  B. Columella developed .... *Micrabacia* E. & H.

III. Septal dentations very tall and spiniform ......
...... *Leptopenus* Moseley

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[151] Yabe and Eguchi, in their recent paper on this genus, have subdivided it into four subgenera, viz.:

1. **Discopsammia** d'Orb. Subgenotype.—**S. bowerbankii** E. & H.
2. **Stephanopsammia** Y. & E. Subgenotype.—**S. discoidea** E. & H.
3. **Stephanophyllia** Michelin s.s. Genotype.—**S. elegans** (Bronn).
4. **Letepsammia** Y. & E. Subgenotype.—**S. formosissima** Moseley.

The subgenera are differentiated mainly on the basis of the columellar structure and the results are not convincing. The first subgenus, **Discopsammia**, is a synonym for **Micrabacia**. The validity of the other subgenera I am not prepared to discuss in detail, but it may be pointed out that **S. implexa** Dennant, referred by Yabe and Eguchi to **Stephanopsammia**, is probably a Micrabacia, as also may be **S. fungulus** Alcock which is placed in **Stephanophyllia** s.s. by Yabe and Eguchi.

[152] It is altogether likely that this genus is a synonym for **Micrabacia**. It was founded by Duncan on a single distorted specimen supposed to lack a columella.

Genus MICRABACIA Milne Edwards and Haime 1849

Genotype.—Fungia coronula Goldfuss 1827. Cenomanian. Essen. (By monotypy).

Notes on the genus.— The type species, *M. coronula* Goldfuss[153] is from the Cenomanian "Mergelgrand" at Essen in the Ruhr Basin, Germany. It has also been reported from localities in England,[154] Ireland,[155] Bohemia,[156] and France.[157] It has been reported from the Turonian in England, Bohemia, and Germany, but it is to be doubted if these forms are identical with *M. coronula.* Specimens labeled *M. coronula* in the United States National Museum (No. 156436 from the British Museum, no locality given; and No. 155214, Folx-les-Caves, Holland) have been described by Stephenson.[158] The specimens first mentioned from the British Museum belong to the *regulares,*[159] and may be typical *M. coronula,* but their height : diameter ratio is much greater than Goldfuss's figured specimen, and are distinct from the specimen from Wiltshire figured by Milne Edwards and Haime, which belongs to the *irregulares,*[160] and also from the specimen figured by Pocta from the Bohemian Cenomanian, which is regular, but with the costae of the 5th cycle much shorter. The specimens from Holland represent another distinct species, belonging to the *irregulares.* The horizon at the locality from which they are stated to come is Maestrichtian, and it is possible that they are specimens of *M. senoniensis* Bölsche,[161] a species which is very high in proportion to its diameter. The type of *M. coronula,* as figured by Goldfuss, is a specimen measuring 7.0 mm. in diameter and 2.5 mm. in height.

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[153] Goldfuss, A. Petrefacta Germaniae, p. 50, pl. 14, fig. 10, 1827.

[154] Milne Edwards, H. and Haime, J. British Fossil Corals, p. 60, pl. 10, fig. 4, 1850.

[155] Haug, E. Traité de Géologie, vol. II, p. 1235, 1912.

[156] Pocta, P. Anthozoen de Böhmischen Kreideformation, p. 32, figs. 12-13. 1887.

[157] Milne Edwards, H. and Haime, J. Hist. Nat. Corall. 3, p. 30, 1857.

[158] Stephanson, L. W. North American upper Cretaceous corals of the genus Micrabacia. **U. S. Geol. Survey Prof. Paper 98-J**, pp. 124-125, pl. 23, figs. 1-5, 1916.

[159] [160] This term is defined on page 155

[161] Bölsche, W. Die Korallen des norddeutschen Jura-und Kreidebirges. **Zeitschr. deutsch, geol. Ges.**, vol. 18, p. 427, pl. 9, fig. 1, 1866.

The septa number 96, in five complete cycles. However, in his figure of the base of the specimen only 78 costae are shown. The species probably belongs to the *regulares.*

The two genera *Asteroseris* de Fromentel[162] and *Microseris* de Fromentel,[163] both represented by single species from the Cenomanian of Le Mans (Sarthe), may prove to belong to this genus, judging from de Fromentel's figures, although he states that the wall is imperforate and that the former possesses pali. In his discussion of *Microseris* he suggests that this may only be an altered *Asteroseris* and points out the resemblance of both to *Micrabacia.* It may be that some of the Cretaceous forms described as *Cycloseris* will prove to belong to *Micrabacia.*

The American upper Cretaceous species of this genus are the subject of an excellent paper by Stephenson.[164] He recognizes seven species and two varieties occurring in the upper Cretaceous of the Atlantic and Gulf coastal plains and Western Interior. I do not think it necessary to redescribe and refigure all of these, an undertaking made needless by Stephenson's work, and it is enough to list them, add a few notes on some of them and consider their occurrence.

In an examination of all the specimens of *Micrabacia* that were available, careful measurements were made to determine whether the main dimensions of the individuals were in a constant ratio for each species. The following is a tabulation of the results:

SPECIES	HEIGHT: DIAMETER	COSTAE 5: DIAMETER
M. arkansasensis	30:100	21:100
*M. taylorensis	33:100	19:100
M. mississippiensis	33:100	8:100
*M. mineolensis	40:100	15:100
M. cribraria	41:100	16:100
*M. rotatilis georgiana	42:100	30:100
*M. rotatilis	43:100	30:100
*M. navarroensis	44:100	16:100

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[162] Fromentel, E. de **Pal. franç. Terr. crét. Zooph.** p. 328, pl. 48, figs. 3a-e, 1867.

[163] Ibid, p. 368, pl. 80, fig. 1, 1870.

[164] Stephanson, L. W. North American upper Cretaceous corals of the genus Micrabacia. **U. S. Geol. Survey Prof. Paper 98-J,** pp. 115-125, pls. 20-23. 1916.

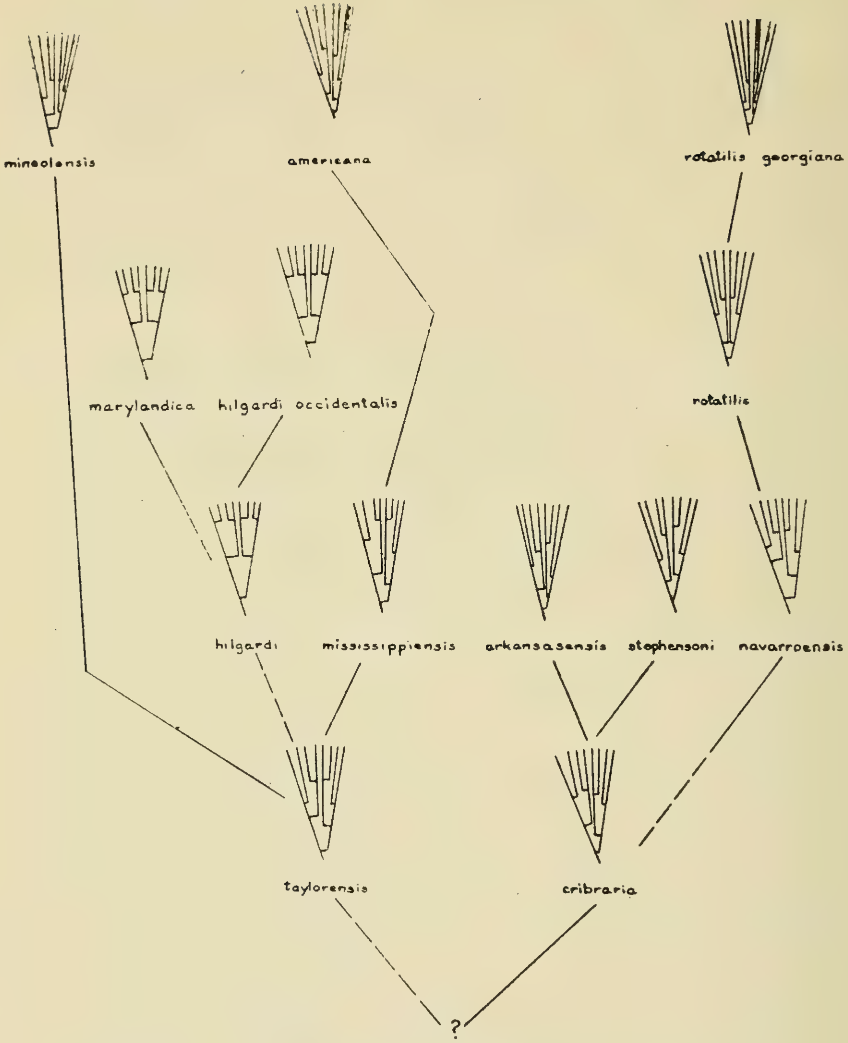
M. stephensoni	44:100	25:100
*M. marylandica	45:100	10:100
M. americana	46:100	22:100
M. americana multicostata	———	25:100
*M. hilgardi	49:100	9:100
*M. hilgardi occidentalis	51:100	14:100

*These species are represented by suites of specimens showing enough different stages of growth to make the ratios fairly accurate.

The ratio of the height to diameter seems to be one of the most constant of the specific characteristics. Other features, such as the depth of the fossette, the dentations of the septa, and the ratio of the length of the fifth cycle of costae to the basal diameter, show more variation within the species. The last mentioned ratio (C 5:D) is an important one, but hard to determine accurately unless the specimens are mature. The depth of the fossette can be determined only in a few cases, due to conditions of preservation and amount of wear. The dentations on the septa are a very variable feature; the septa of the higher cycles tend to have a few more teeth, and the number of teeth grows fewer in passing from the base towards the fossette along the septal margin. The ornamentation of the costae is an important specific character, but account must be taken of destruction of granulations or beads due to wear. This ornamentation may vary from forms which show practically no ornamentation (*M. rotatilis*) to others in which the granules are so large as to obscure the costae (*M. hilgardi*). There is much variation in specimens of the same species in the degree of concavity or flatness of the base of the corallum.

Although it may seem to some that the species of this genus have been unnecessarily multiplied and that variations of one species have been magnified into species, there is no doubt that

Fig 4


mineolensis
americana
rotatilis georgiana
marylandica
hilgardi occidentalis
rotatilis
hilgardi
mississippiensis
arkansasensis
stephensoni
navarroensis
taylorensis
cribraria
?

Relationships of American Species of MICRABACIA the validity of the species can be maintained. The characters of each species are well-defined even from the earlier stages, as proved by the study of numerous individuals of the same species. Furthermore, these species are confined to definate stratigraphic horizons and persist over a considerable area, and their value in correlation is not to be underestimated.

I have divided the species into two groups which I call the *Regulares* and *Irregulares.* These divisions are based on the relation of the last or 5th cycle of costae to the rest. In the group *Regulares,* all of the costae of the 5th cycle have the same length. In the second group, the *Irregulares,* the costae of the last cycle are unequal in length, those fusing to the costae of the interspaces next to the 3rd cycle of septa always being shorter than the others.

Synopsis of American species of Micrabacia.—

A. *Regulares*:
  I. Costae heavily granulated, especially near center of base; height nearly as much or more than the basal diameter.
    a. Costal ratio about 9:100 .... *M. hilgardi* Stephenson
    b. Costal ratio about 14:100 .... *M. hilgardi occidentalis* n. var.
  II. Costae granulated but always distinct to center; height less than basal diameter; costal ratio about 10:100 .... *M. marylandica* Stephenson

B. *Irregulares*:

This large group is divided into three minor groups on the basis of the ornamentation and relative size of the costae.

  I. *Rotatilis*-group. Costae smooth or very slightly beaded, relatively narrow.
    A. Costae smooth.
      1. Costal ratio about 16:100 ... *M. navarroensis* n. sp.
      2. Costal ratio about 30:100 .... *M. rotatilis* Stephenson

B. Costae faintly beaded ......
...... *M. rotatilis georgiana* Stephenson

II. *Americana*-group. Costae beaded, but remaining distinct and not very broad.
  A. Synapticulae in center of base nearly as large, or as large as the costae, which are relatively narrow:
    1. Costal ratio 16:100 ...... *M. cribraria* Stephenson
    2. Costal ratio 21:100 ...... *M. arkansasensis* n. sp.
    3. Costal ratio 25:100 .... *M. stephensoni n. sp.*
  B. Costae prominent to center of base, broad or subacute:
    1. Costae in 5 complete cycles:
      a. Costal ratio 8:100 ......
      ...... *M. mississippiensis* Stephenson
      b. Costal ratio 16:100 ...... *M. taylorensis* n. sp.
      c. Costal ratio 22:100 ...... *M. americana* M. & H.
    2. Costae in 5 complete cycles and part of 6th:
      a. Costal ratio 25:100 ......
      ...... *M. americana multicostata* Stephenson

III. *Mineolensis*-group. Costae heavily beaded within area bounded by 5th cycle of costae; obscured toward center .... *M. mineolensis* Stephenson

The oldest representatives of the genus in North America are *M. cribaria* and *M. taylorensis.* In Fig. 4 is suggested the relationships of the various groups during the upper Cretaceous.

A. Regulares.

Micrabacia hilgardi Stephenson

Micrabacia hilgardi Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 120, pl. 22, figs. 1-6.

Micrabacia hilgardi Wade 1926. U. S. Geol. Survey Prof. Paper 137, p. 26, pl. 1, figs. 3-4, 6-8.

Micrabacia hilgardi Whitney 1928. Bull. Am. Paleont. vol. 12, no. 48, p. 226.

Dimensions.—(w=worn specimen, p=*Diafungia*-form)

U. S. N. M. No.	Specimen	Height	Basal Diameter
32001	1. (Type)	3.0 mm.	5.5 mm.
32010	2.	3.1	5.75
32009	3.	2.85	5.25
32000	4. (w)	2.6	5.5

32010	5.	2.35	5.0
”	6. (w)	2.30	4.6
”	7.	2.25	4.75
”	8. (w)	2.15	4.5
”	9.	2.1	4.0
”	10. (w)	2.1	4.0
”	11.	2.1	4.3
32012	12.	2.0	4.8
32010	13. (w)	2.0	4.25
”	14.	1.9	4.3
”	15.	1.8	3.6
”	16. (w, p)	1.6	3.3
”	17.	1.5	3.5
”	18.	1.1	2.3

Type and homeotypes.—United States National Museum, No. 32001.

Occurrence: *Type locality.*—*Exogyra costata* zone, Lee's old mill site, 2 miles northeast of Keownville, Union County, Mississippi. (U. S. G. S. Mes. Loc. 6782).

Other localities.—*E. costata* zone: (a) Eufaula, Alabama. (U. S. G. S. Mes. Loc. 854). (b) Mercers Mill Creek, near Georgetown, Pa. (U. S. G. S. Mes. Loc. 5417). (c) Chattahoochee River, 2 miles below Eufaula, Alabama. (U. S. G. S. Mes. Loc. 857). (d) Coon Creek, McNairy County, Tenn.

Remarks.—This species is distinguished by the great height in proportion to the basal diameter, which is in the ratio of 49:100, which is slightly less than that of var. *occidentalis,* the Texas equivalent of this species. The costal ratio (C_5 : D) is about 9:100, much lower than that of the variety. The heavy granulations of the costae are a notable feature, as in *M. marylandica,* which is a lower form and which has fewer septal dentations.

Both this species and its variety and *M. marylandica* seem to be related to *M. taylorensis,* although *M. marylandica* probably is closer to *M. hilgardi* than to the Taylor species. *M. mineolensis* is another related form, but is close to *M. taylorensis* by reason of the irregular character of the fifth cycle of costae.

Micrabacia hilgardi occidentalis n. var. Pl. 15, figs. 14-15

Description.—This variety is close to *M. hilgardi* except for two points, the costal ratio, which is about 14:100, and the greater height: diameter ratio, which is about 51:100. In many specimens the base is deeply excavated, but as I have pointed out elsewhere, such a character is not specific or even varietal. In all respects the two forms are alike. Both have about 12 septal dentations in a distance of 12 mm. The bifurcations of the costae of the fourth and fifth cycles of costae occur at regular intervals. The costal granulations are coarse, except on the last cycle, forming a marked contrast between the outer zone and the inner zone of granulations.

Dimensions.—

SPECIMEN	LOCALITY	HEIGHT	BASAL DIAMETER
1.	518	4.8 mm.	2.2 mm.
2.	"	5.0	2.8
3.	"	6.0	3.0
4.	"	6.6	3.5

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—Navarro formation in a creek one-quarter mile north of Corsicana, Navarro County, Texas. (U. S. G. S. Mes. Loc. 518).

Other localities.—Nacatoch sand member of the Navarro formation, from concretions in a field north of the Dallas road, 0.6 miles west of Kaufman, Kaufman County, Texas. (U. S. G. S. Mes. Loc. 14103).

Remarks.—This variety has the tallest corallum of all the American species of *Micrabacia,* and it is very close to typical *M. hilgardi.* *M. mineolensis* differs by its lower corallum and irregular fifth cycle of costae.

Micrabacia marylandica Stephenson

Micrabacia marylandica Stephenson 1916. Maryland Geol. Survey Upper Cretaceous, pp. 755-757, pl. 48, figs. 1-4.

Micrabacia marylandica Stephenson 1916. U. S. Geol Survey Prof. Paper 98-J, p. 121, pl. 22, figs. 7-10.

Micrabacia marylandica Whitney 1928. Bull Am. Paleont. vol. 12, no. 48, p. 226.

Dimensions

SPECIMEN	LOCALITY	HEIGHT	BASAL DIAMETER
1.	Brightseat	2.0 mm.	4.9 mm.
2.	"	2.1	5.1
3.	"	2.1	5.15
4.	Friendly	2.15	5.75
5.	"	2.25	6.75
6.	Brightseat	2.75	6.1
7.	"	2.8	6.3
8.	"	3.2	7.15

Types.—Collection of the Maryland Geological Survey, on deposit at United States National Museum.

Occurrence: *Type locality.*—Monmouth formation (*E. costata* zone), bed of small branch seven-eighth of a mile southwest of Brightseat and three-eighths of a mile south of the Sheriff road, Prince Georges, County, Maryland.

Other locality.—Half a miles west of Friendly, Prince Georges County, Maryland.

Remarks.—In the remarks on *M. hilgardi,* I have noted the relationships of this species, which is distinguished by the heavily granulated costae, low costal ratio, (10:100), and low corallum, with the height: diameter ratio of 45:100, and fewer septal teeth, (10/mm.). The two specimens from Friendly have a lower corallum, (35:100), than is usual for this species, but are otherwise identical. The costal granulations are not quite as heavy as in *M. hilgardi,* or its variety.

B. Irregulares.

I. Rotatilis-group

Micrabacia navarroensis n. sp. Pl. 15, figs. 16-17

Description.—Corallum sub-hemispherical, with a flat or often concave base. Sides steep, slightly convex. Fossette shallow. Base ornamented with five complete cycles of costae irregularly arranged, (see Fig. 4). They are rounded, with narrow interspaces, and smooth. At the margins of the base they are a little higher than nearer the center, with sub-acute edges. In the central area they often tend to become sinuous or vermiculate. The septa are in five complete cycles, and are thin and imperforate, with an average of 8 to 9 dentations per mm. on their outer edges. Above the wall they are united by a few large synapticulae which remain isolated. Their sides are granulated or ridged by low rounded beads. The columella is well-developed.

Dimensions.—

SPECIMEN	HEIGHT	BASAL DIAMETER
1.	2.5 mm.	5.6 mm.
2.	2.5	6.0
3.	2.5	5.6
4.	2.6	5.75
5.	2.6	6.0
6.	2.8	6.25
7.	2.8	6.3
8.	2.8	6.3
9.	3.0	6.5
10.	3.0	7.0
11. (Type)	3.5	7.5

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—Navarro formation in sandy concretions in a draw about one-half mile west of the Austin-Lockhart road about six miles north of Lockhart, Caldwell County, Texas. (U. S. G. S. Mes. Loc. 13777).

Remarks.—About 100 specimens of this well-marked species were examined, all from the same concretion, in which they formed a band of about 2½ cm. thick, closely packed together. By its smooth costae this species is closely related to *M. rotatilis* of the *E. costata* Zone of Maryland. The main distinction between the two forms is the difference in the ratios of the shorter costae of the fifth cycle of the diameter, 16:100 in the Mavarro species as compared with 30:100 in the Maryland species. *M. rotatilis georgiana* differs by its thinner, sharper, and faintly beaded costae.

Micrabacia rotatilis Stephenson

Micrabacia rotatilis Stephenson 1916. Maryland Geol. Survey, Upper Cretaceous. p. 753, pl. 49, figs. 1-4.

Micrabacia rotatilis Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 119, pl. 21, figs. 1-4.

Micrabacia rotatilis Whitney 1928. Bull. Amer. Pal., vol. 12, no. 48, p. 227.

Dimensions.—

SPECIMEN	HEIGHT	BASAL DIAMETER
1. (Type)	4 mm.	9 mm.
2.	3.1	7.1
3.	2.1	4.9

Type.—Collection of the Geological Survey of Maryland, on deposit at the United States National Museum.

Occurrence: *Type locality.*—Monmouth formation, (*E. costata* Zone); bed of a small branch about seven-eighths of a mile southwest of Brightseat and three-eighths of a mile south of the Sheriff road, Prince Georges County, Maryland.

Other localities.—Near McNey's Corners, about a mile west of Friendly, Maryland. One doubtful specimen from Seat Pleasant, Maryland.

Remarks.—This species is well-marked by its corallum of medium height and by its smooth costae with an unusually high costal ratio (C5: D), 30:100. It appears to have been derived from *M. navarroensis*, but this is only an assumption, because no similar forms have been met with elsewhere in the Coastal Plain region.

Micrabacia rotatilis georgiana Stephenson

Micrabacia rotatilis, var. georgiana Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 120, pl. 21, figs. 5-8.

Dimensions.—

U. S. N. M. No.	SPECIMEN	HEIGHT	BASAL DIAMETER
32017	1.	1.5 mm.	4.0 mm.
"	2.	1.75	4.3
———	3.	2.0	5.0
32017	4.	2.6	6.0
"	5.	2.8	6.0
31998	6. (Type)	3.0	7.0

Type.—United States National Museum No. 31998.

Occurrence: *Type locality.*—*E. costata* zone (upper part) Mercers Mill Creek, near Georgetown, Quitman County, Georgia. (U. S. G. S. Mes. Loc. 5417).

Remarks.—This variety is probably derived from the typical form from Maryland, and shows some slight graduation in the manner of the costal ornamentation into the *americana*-group, but the unusually high costal ratio of the variety suggests no more than a remote connection. The main distinction between this variety and the typical form is in the costal ratio, which is 40:100, the highest observed in any of the American species of *Micrabacia.*

II. Cribaria-group

Micrabacia cribaria Stephenson

Micrabacia cribraria Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 117, pl. 20, figs. 1-3.

Micrabacia cribraria Stephenson 1923. North Carolina Geol. and Econ. Survey, vol. 5, pt. 1, pp. 66-67, pl. 9, figs. 15-17.

Micrabacia cribraria Wade 1926. U. S. Geol. Survey Prof. Paper 137, p. 27, pl. 1, figs. 9-10.

Micrabacia cribraria Whitney 1928. Bull. Am. Paleont. vol. 12, no. 48, p. 226.

Type.—United States National Museum No. 31996.

Ideotypes.—United States National Museum Nos. 32013, 32014.

Occurrence: *Type locality.*—Snow Hill calcareous member of Black Creek formation, (upper *E. ponderosa* zone), Whiteley Creek Landing, Neuse River, North Carolina. (U. S. G. S. Mes. Loc. 5354).

Other localities.—(a) Snow Hill calcareous member of Black Creek formation, Kerr's Cove, Black River, North Carolina. (U. S. G. S. Mes. Loc. 5362). (b) *E. ponderosa* zone, west end of Central of Georgia Railroad cut, one half mile west of Union Springs, Bullock County, Georgia. (U. S. G. S. Mes. Loc. 6815). (c) *E. ponderosa* zone, Conecuh Falls, Union Springs, Bullock County, Georgia. (U. S. G. S. Mes. Loc. 6820). (d) Selma chalk, Tupelo road 8 miles west of Fulton, Lee County, Georgia. (U. S. G. S. Mes. Loc. 6452).

Remarks.—This species is distinguished by the character of the central area of the base. The costae are indistinct due to the large size of the synapticular bars between them which are equal in size to the costae, resulting in the formation of a recticulate mesh-work. The ratio of the height to the diameter is about 41:100 and of the shorter costae of the fifth cycle to the basal diameter about 16:100.

The two specimens from station 6820 referred by Stephenson to this species are abnormal forms similar to the abnormal specimen of *M. taylorensis* (*Diafungia*-form) described under that species.

The two specimens from the Selma chalk are doubtfully referred to this species by Stephenson. They are in the form of external basal molds and their identification is uncertain. This species is the oldest representative of a group marked by the relatively narrow costae and great prominence of the basal synapticulae in the central area of the base. Often the basal synapticulae are equal in size to the costae and with them form a reticulate mesh-work. *M. cribraria* has the smallest costal ratio (16:100) of the three species placed in this group and usually has a slightly higher number of septal teeth.

It is doubtful if the two specimens from Coon Creek (U. S. N. M. No. 32705) can be definitely placed in *M. cribraria.* They are badly worn, as Wade's figures show, and the specific characters lost.

This species has been reported by Böse and Cavins[165] from beds in Coahuila, Mexico, which they refer to upper Santonian, and which are the equivalents of the Taylor marl of Texas, associated with *Placenticeras syrtale* and *Exogyra ponderosa.* This is the species of *Micrabacia* referred to *M. americana* by Aguilera[166].

Micrabacia arkansasensis n. sp. Pl. 15, figs. 21-22

Description.—Corallum low, subdiscoidal, subhemispherical, sides very little convex. Fossette shallow. Base flat or very slighty concave, marked by radiating costae. The costae are relatively narrow, marked by low beads on their edges. The basal synapticulae are large towards the center, giving it a cribriform appearance, as in *M. cribraria.* The costae of the fifth cycle are irregular in length, the shorter ones having a ratio of about 21:100. The beads of the costae are small and more or less acute. The septa, like the costae, are in five complete cycles, laterally granulate with about 8 dentations per millimeter on the edges near the base.

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[165] Böse, E. and Cavins, O. A. The Cretaceous and Tertiary of southern Texas and northern Mexico. **Univ. of Texas, Bull.** 2748, p. 36, 1927.

[166] Aguilera, J. C. Aperçu sur la géologie de Méxique pour servir d'explication à la carte géologie de l'Amérique du nord. **Congr. géol. intern., C. R. de la X sess.**, Mexico, p. 241, 1907.

Dimensions.—

SPECIMEN	HEIGHT	BASAL DIAMETER
1.	1.5 mm.	5.5 mm.
2.	2.3	6.6
3.	2.4	6.8
4.	(?)	6.2

Type and paratypes.—United States National Museum No. 22664.

Occurrence: *Type locality.*—Upper Marlbrook marl (uppermost Taylor), one mile southeast of Hearn, 7 miles west of north of Arkadelphia, Clark County, Arkansas. (U. S. G. S. Mes. Loc. 16243).

Remarks.—This species is very close to *M. cribraria,* and may be considered the western representative of that species. The distinction between the two is the much lower corallum of *M. arkansasensis* (30:100), the lowest corallum of all the American species. The costae of the fifth cycle are also longer than those of *M. cribraria,* but not as long as those of *M. stephensoni* of Texas. The costae have finer granulations than those of *M. cribraria* or *M. stephensoni.*

The type and other specimens are imbedded in a slab which also contains what appear to be several specimens of *Caryophyllia stephensoni.*

Micrabacia stephensoni n. sp. Pl. 15, figs. 18-20

Description.—Corallum quite low, sub-discoidal, with a flat or slightly concave base and a shallow fossette. Sides very little convex. Base marked by five complete cycles of costae, which are unequal in length, those of the last cycle nearest the margin having a ratio of about 25:100. They are relatively narrow, rounded and beaded with rather large granulations which are not as acute, and larger, than in *M. arkansasensis.* In the central area of the base the synapticulae are large and stout, but smaller than the costae, and with them form a mesh-work. The septa are in five complete cycles, those of the first cycle, as usual, being the tallest. On their outer margins there are from 7 to 9 rounded, broad teeth per mm. Towards the fossette the teeth become larger and closer together.

Dimensions.—

Locality	Height	Basal Diameter
16145	2.0 mm.	4.5 mm
"	2.2	5.0
"	2.2	6.0
"	3.4	6.5
"	3.5	6.5
"	3.5	7.8
(R. King, Coll.)	3.75	8.0
" "	(?)	7.5

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—Upper Taylor marl, bluff on Cottonwood Creek, one mile southwest of Manda, Travis County, Texas. (U. S. G. S. Mes. Loc. 16145).

Other localities.—(a) Near Kimbro, Travis County, Texas. (Collected by R. King). (b) North-facing bluff on Brushy Creek, one and one quarter mile southeast of Rice's crossing, Williamson County, Texas. (U. S. G. S. Mes. Loc. 16144).

Remarks.—This species, which is distinguished by its granulated but narrow costae and cribiform central area, shows many characters indicative of a position between *M. cribraria* and *M. mississippiensis,* but it is closer to the former by reason of its higher costal ratio and costal markings. It is distinguished from *M. arkansasensis* by its more coarsely granulated costae and higher corallum.

Micrabacia mississippiensis Stephenson

Micrabacia mississippiensis Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 123, pl. 23, figs. 9-11.
Micrabacia mississippiensis Whitney 1928. Bull. Am. Paleont. vol. 12, no. 48, p. 226.

Dimensions.—	Height	Basal Diameter
	2 mm.	6 mm.

Holotype.—United States National Museum No. 32008.

Occurrence: *Type locality.*—*E. costata* zone, Lee's old mill sits, two miles northeast of Keownville, Union County, Mississippi. (U. S. G. S. Mes. Loc. 6782).

Remarks.—The holotype is well-preserved and shows clearly the characters of this species. As with the other members of the *americana*-group, the costae are thick and lightly beaded. The low corallum and low costal ratio, (8:100), easily distinguish it from the other species of the group. *M. mississippiensis* is the only representative of this group in the *E. costata* zone in the Gulf Coast area.

Micrabacia taylorensis n. sp. Pl. 15, figs. 1-7

Description.—Corallum low, subdiscoidal; base flat or very slightly convex, upper surface regularly convex, with a circular fossette a little less than one-third as deep as the total height of the corallum. The ratio of the height to the basal diameter, (average of 5 specimens), is 33:100. The lower surface is covered by radiating bifurcating costae which alternate with the septa. The costal system starts with six costae, which, by successive bifurcation form 12, 24, 48, and 96 costae, five complete cycles and six regular systems. The costae of the fifth cycle have an average ratio to the basal diameter of 19:100. The costae are thin and equal, separated by a narrow groove, rounded, with small beads or granulations on the upper edges. The septa are in 5 complete cycles, corresponding to the costae in number but not in position or structure. In structure they are thin and imperforate, laterally granular. The lateral granules are often fused into fan-like ridges which become higher and more acute as the septal margin is approached, so that the septal margin as viewed from above appears to be heavily carinate, the "carinae" corresponding to the septal teeth, which number from 8 to 9 in a space of 1 mm. The septa of the first cycle are higher and more prominent than the rest, and are flanked by the nearly equally tall septa of the cycle which forms the boundaries of the delta of higher cycles. In the case of specimens with a diameter less than 5.0., the full number of septa (96) is not present, the last 12 being undeveloped. Synapticulae are present mostly in the basal parts of the corallum, where they form the wall in the usual fashion and fuse upwards in short rows or remain simple. The columella is a well-developed mass of trabeculae. The base is often covered with a thin calcareous film which obscures the wall perforations and is a secondary deposit rather than an epitheca.

Dimensions.—

LOCALITY	HEIGHT	BASAL DIAMETER	SEPTA
12894	1.3 mm.	4.2 mm.	84
"	1.5	4.75	84
"	1.6	5.2	96
"	1.8	5.3	96
7617	2.0	5.5	96

Type and paratypes.—United States National Museum.

Occurrence: *Type locality.*—Taylor marl, on slope of Mustang Creek valley, just south of Taylor, Williamson County, Texas. (U. S. G. S. Mes. Loc. 12894). (Collected by L. W. Stephenson).

Other localities.—(a) Taylor marl, 170 feet above the base, 5 feet below phosphatic zone, on Manor road, 7 miles northeast of Austin, Travis County, Texas. (Texas Christian University Collection). (b) Taylor marl, in bed of a small branch in a field one-third of a mile east of the San Marcos-Styles Store road, two and one-quarter miles south of San Marcos court house, Hays County, Texas. (U. S. G. S. Mes. Loc. 7617). (Collected by L. W. Stephenson). (c) Basal Taylor on Big Walnut Creek west of Sprinkle, Travis County, Texas. (University of Texas Collection).

Remarks.—This species has the next to the lowest height: diameter ratio of the American species of the genus.

The single specimen from below the phosphatic zone of the lower Taylor is an interesting abnormality. The septa within one of the six systems are usually large, as are also the costae, and from a group or wedge extending to and slightly beyond the center of the corallum, (Pl. 15, fig. 7). This condition appears to be analogous to *Diaseris* in the *Fungiae* (*Diaseris*-form). *Diafungia* Duncan[167], which is apparently based upon a single specimen, may prove to be this form of *Micrabacia*, although it is stated to lack a columella.

This species and *M. cribraria* are the oldest representatives of this genus now known in this country. It is probably the direct ancestor of several groups of species which appear in higher horizons, as indicated in the phylogenetic chart (Fig. 4).

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[167] Duncan, P. M. Revision of the families and genera of the Madreporaria. **Jour. Linn. Soc. London, Zool.**, vol. 17, p. 417, 1884.

Most of the specimens are poorly preserved, particularly the basal parts. The costae are usually destroyed, but one specimen shows that they are relatively thick, with rounded granulations.

Micrabacia americana Meek Pl. 16

Micrabacia coronula Meek & Hayden (non E. & H., Goldfuss) 1861. Philadelphia Acad. Nat. Sci. Proc., vol. 12, p. 430.

Micrabacia americana Meek 1864. Check List Inv. Foss. North America, Cretaceous and Jurassic, p. 2.

Micrabacia americana Meek 1876. U. S. Geol. Survey Terr. (Hayden) Rept. 9, p. 1, pl. 28, figs. 1a-d.

Micrabacia americana Stephenson 1918. U. S. Geol. Survey Prof. Paper 98-J, p. 118, pl. 20, figs. 4-5.

Micrabacia americana Whitney 1928. Bull. Am. Paleont. vol. 12, no. 48, p. 226.

Dimensions.—

U. S. N. M. No.	HEIGHT	BASAL DIAMETER
22976	3.5 mm.	7.5 mm.
21896	3.0	6.2
”	3.3	7.0
”	2.2	6.0
”	2.5	6.5

Type.—United States National Museum No. 456.

Homeotypes.—U. S. N. M. Nos. 21896, 22976.

Occurrence: *Type locality.*—Fox Hills sandstone, Moreau River, South Dakota.

Other localities.—(a) Mesaverde group, San Juan Basin, New Mexico[168]. (b) Concretion zone at the base of Fox Hills sandstone, east end of Greasewood Dome, near Jackson Reservoir, Morgan County, Colorado. (U. S. G. S. Mes. Loc. No. 16183). (Collected by J. B. Reeside, Jr. 1932). (Homeotypes).

Remarks.—The name of this species properly dates from 1876, when it was described by Meek, whose *M. americana* of 1864 is a *nomen nudum.*

The type specimens of this species are poorly preserved, but the characters are well-shown by the other specimens whose dimensions are given above. The chief feature of this species is the long costae of the fifth cycle, with a ratio of 22:100, as compared with *M. mississippiensis,* to which it is probably related.

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[168] Reeside, J. B., Jr. Upper Cretaceous and Tertiary formations of the western part of the San Juan Basin of Colorado and New Mexico. U. S. Geol. Survey Prof. Paper 134, p. 15, 1924.

Aguilera[169] has reported this species from the upper Santonian of central Mexico but it is to be doubted whether this is the same species, and it is likely that the Mexican species is closer to those found in the Navarro formation. (See remarks under *M. cribaria*).

Weller[170] has referred to *M. americana* a number of specimens from the upper Cretaceous of New Jersey, but it is unlikely that any of them belong to this species. Stephenson[171] discusses the specimens briefly and thinks that those figured by Weller from the Woodbury clay at Lorillard may be *M. cribraria.*. Other specimens were reported from the Merchantville clay and Wenonah sand. Better specimens from Haddonfield were in the Academy of Natural Sciences of Philadelphia, but have been lost.

Micrabacia americana multicostata Stephenson Pl. 13, fig. 9

Micrabacia americana var. multicostata Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 119, pl. 20, fig. 6.

Micrabacia americana var. multicostata Whitney 1928. Bull. Am. Paleont., vol. 12, no. 48, p. 226.

Holotype.—United States National Museum No. 31997.

Occurrence: *Type locality.*—"Probably upper Montana group, and perhaps from the locality 20 miles southwest of Mingusville, Montana." (Label). (Homer Squyer Collection).

Remarks.—No other specimens of this unusual form have been seen. There are parts of three other specimens in the same block of matrix as the type, all of which are typical *M. americana*, and Stephenson's suggestion that this form is perhaps only an abnormal specimen rather than a variety may be correct. The costae of the sixth cycle are more or less developed, a most unusual condition in this genus. The costae of the sixth cycle which are developed, 27 in this case, are unequal in length. Another unusual feature is that some of the costae die out before reaching the margin of the corallum.

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[169] Aguilera, J. C. Aperçu sur la géologie de Méxique pour servir d'explication à la carte géologie de l'Amérique du nord. **Congr. géol. intern., C. R. de la X sess.**, Mexico. p. 241, 1907.

[170] Weller, S. Cretaceous Paleont. New Jersey, pp. 101-103, 126, 183, 271-272, pl. 5, figs. 14-17, 1907.

[171] Stephenson, L. W. North American upper Cretaceous corals of the genus Micrabacia. **U. S. G. S. Prof. Paper** 98-J p. 118, pl. 20, figs. 4-5, 1916.

III. Mineolensis-group

Micrabacia mineolensis Stephenson Pl. 15, figs. 8-13

Micrabacia mineolensis Stephenson 1916. U. S. Geol. Survey Prof. Paper 98-J, p. 122, pl. 23, figs. 6-8.

Micrabacia mineolensis Whitney 1928. Bull. Am. Paleont. vol. 12, no. 48, p. 226.

Micrabacia mineolensis Adkins 1928. Univ. of Texas, Bull. 2838, p. 77.

Type.—United States National Museum, No. 32006.

Plesiotypes.—Texas Christian University, Ft. Worth, Texas; United States National Museum.

Occurrence: *Type locality.*—Well of Hoard Oil and Gas Company, 7 miles west of Mineola, Wood County, Texas, depth 3146-3160 feet. (U. S. G. S. Mes. Loc. 9369).

Other localities.—(a) Navarro formation, on Onion Creek, Travis County, Texas. (Texas Christian University Collection). (b) Navarro formation, chalky marl member, loose on slope 15 feet above base, bluff on Onion Creek, one quarter mile below Bastrop road crossing, two and one half miles west of old Garfield, Travis County, Texas. (U. S. G. S. Mes. Loc. 15532). (c) Navarro formation, about three and one-half miles northwest of Bazette, four miles northeast of Roane, Navarro County, Texas. (U. S. G. S. Mes. Loc. 12922). (d) Nacatoch sand (Upper Navarro) northeast-facing slope of Big Caddo Creek valley, one and eight-tenths miles northeast of Quinlan, Hunt County, Texas. (U. S. G. S. Mes. Loc. 16171). (Collected by F. B. Plummer).

Remarks.—A fine series of specimens of this species is in the Texas Christian University Collection. Their dimensions are as follows, together with other specimens:

	HEIGHT	BASAL DIAMETER
T. C. U. Collection	0.8 mm.	2.6 mm.
" " " "	1.0	2.75
" " " "	1.6	4.3
" " " "	1.8	4.4
" " " "	1.8	4.4
" " " "	2.2	5.2
" " " "	2.5	6.0
U. S. G. S. Mes. Loc. 15532	1.9	5.1
" " " " " " "	2.0	4.8
" " " " " " " (Type)	2.5 (?)	[illegible].5

The distinguishing feature of this species is the heavy granulations on the costae within the ring formed by the last cycle of costae. The granules are large but irregular in size within the ring, almost obliterating the costae, but very small outside of the ring, the change in size being abrupt. The ratio of the height to the basal diameter averages 40:100. None of the specimens are as well-preserved structurally as the type specimens (U. S. N. M. 32006), although they retain their original form. The type specimens show a slightly convex base, the margin being abruptly directed downward, whereas the other specimens have a flat or slightly concave base. This condition, however, may be an adaptation to the character of the bottom upon which the specimens lived.

This species, although it resembles those of the *hilgardi*-group closely, is distinguished from them by the irregular length of the costae of the fifth cycle, indicating a relationship with *M. taylorensis* rather than by a direct connection with the *hilgardi*-group.

CHRONOLOGICAL LIST OF WORKS IN WHICH NORTH AMERICAN CRETACEOUS CORALS ARE DESCRIBED

1834 Morton, S. G. Synopsis of the organic remains of the Cretaceous Group of the United States. Philadelphia.

1845 Lonsdale, Wm. Account of six species of Polyparia obtained from Timber Creek, New Jersey. *Quart. Jour. Geol. Soc. London,* vol. 1, pp. 65-75. ill. (Most of the species are bryozoa).

1888 Roemer, F. Ueber eine durch die Häufigkeit hippuritenartiger Chamiden ausgezeichnete Fauna der oberturonen Kreide von Texas. *Pal. Abh.,* bd. 4, heft. 4, pp. 281-296, 3 pls.

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1852 Roemer, F. Die Kreidebildungen von Texas und ihre organischen Einschlusse. Bonn.

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1870 Bölsche, W. Polypi. In: Credner. Die Kreide von New Jersey. *Zeitschr. deusch. geol. Ges.,* vol. 22, pp. 215-217.

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1929 Hoffmeister, J. R. A new fossil coral from the Cretaceous of Texas. *Proc. U. S. Nat. Mus.,* vol. 76, Art. 23, pp. 3, 2 pls.

1932 Wells, J. W. Corals of the Trinity group of the Comanchean of central Texas. *Jour. Paleont.* vol. 6, no. 3, pp. 225-256, pls. 30-39.

EXPLANATION OF PLATES

PLATE 1 (14)

EXPLANATION OF PLATE 1 (14)

DIAGRAMS

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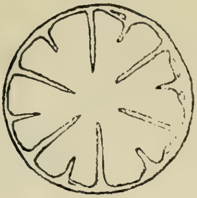
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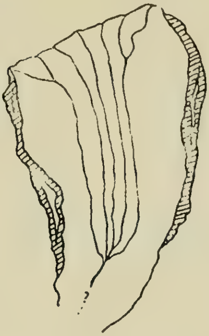
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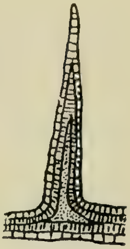
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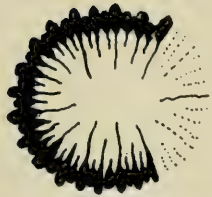
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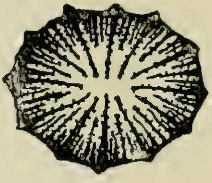
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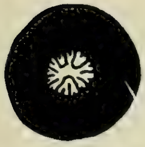
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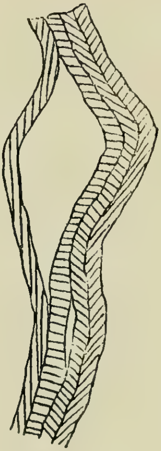
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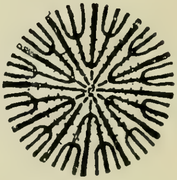
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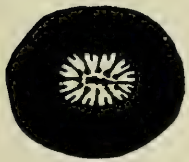
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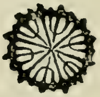
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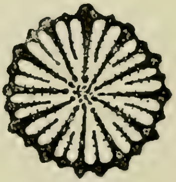
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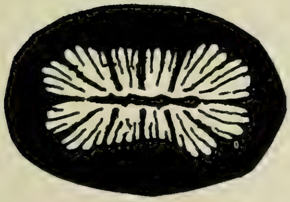
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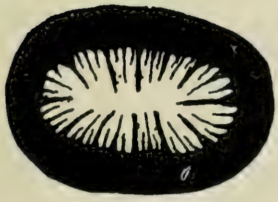
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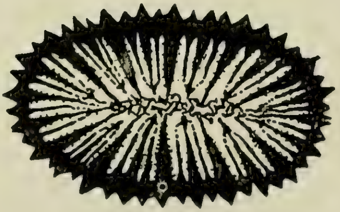
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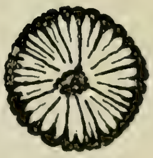
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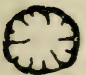
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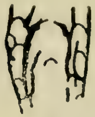
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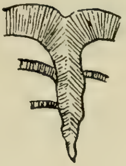
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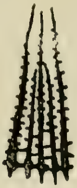
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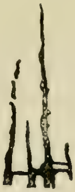
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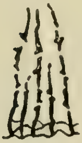
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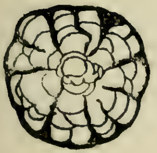
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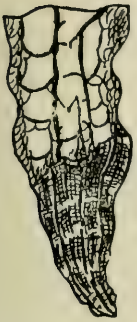
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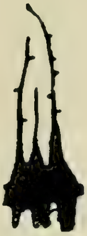
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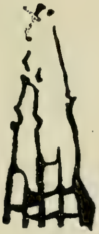
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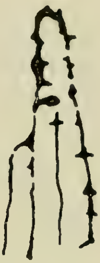
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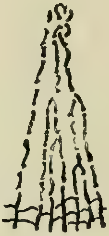
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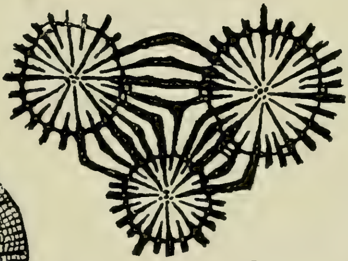
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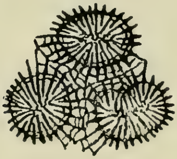
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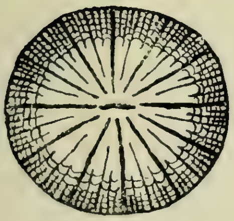
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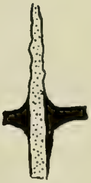
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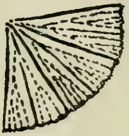
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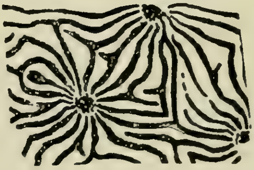
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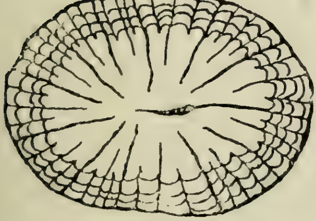
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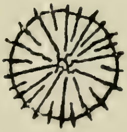
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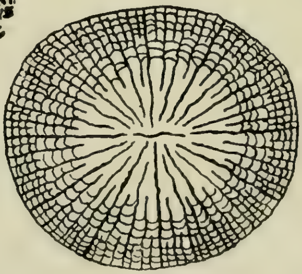
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Plate 3 (16)

EXPLANATION OF PLATE 3 (16)

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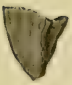
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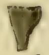
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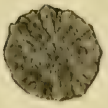
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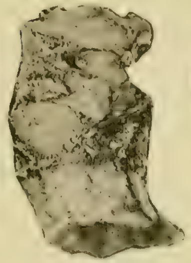
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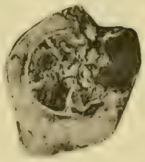
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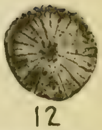
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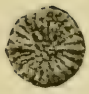
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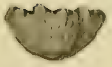
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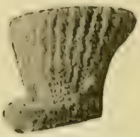
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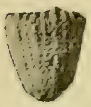
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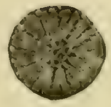
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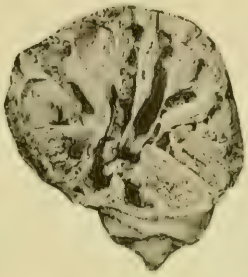
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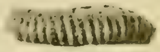
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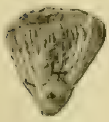
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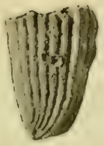
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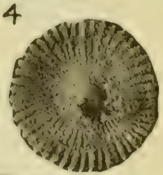
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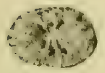
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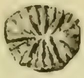
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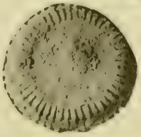
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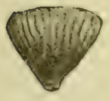
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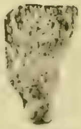
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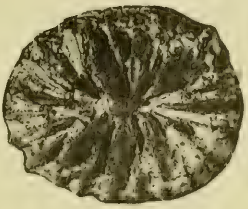
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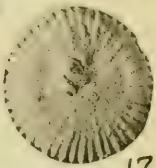
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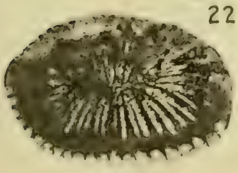
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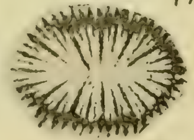
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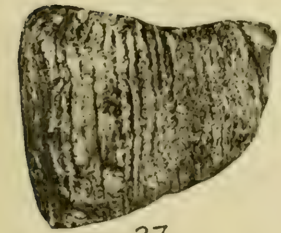
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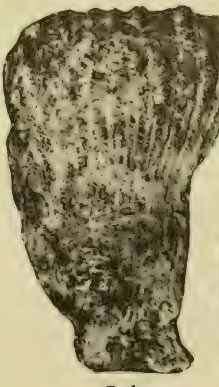
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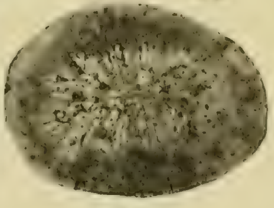
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PLATE 4 (17)

EXPLANATION OF PLATE 4 (17)

Figure — Page

1. **Trochosmilia stainbrooki**, n. sp. — 51
Lateral view of ideotype, x1.
2. Lateral view of type, x1.
3. Lateral view of type, x1.
4. Calice of type, x1.
5. Lateral view of ideotype, x1.
6. Lateral view of paratype, x1.
7. Lateral view of ideotype, x1.
8. Lateral view of paratype, x1.

9. **Parasmilia austinensis** Roemer — 56
Calice of tophomeotype, x1.
10. Lateral view of specimen in fig. 9, x1.
11. Lateral view of another tophomeotype, x1.

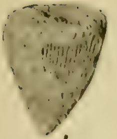
12. **Parasmilia graysonensis**, n. sp. — 58
Lateral view of type, x2.

13. **Parasmilia ? sp.** — 59
Calice, x1.
Calice, x1.
14. Lateral view of specimen in fig. 13.

15. **Coelosmilia americana** Roemer — 56
Lateral view of type, (Roemer's figure).
16. Calice of type, (Roemer's figure).

17. **Coelosmilia texana** (Conrad) — 52
Lateral view of specimen from west Texas, x1.
18. Lateral view of homeotype from west Texas, x1.
19. Specimen from north Texas, x1. (Homeotype).
20. Homeotype from west Texas, x1.
21. Homeotype from west Texas, x1.
22. Type specimen. (Conrad's figure).

23. **Pleurosmilia craginiana**, n. sp. — 60
Paratype, x1.
24. Type, x1.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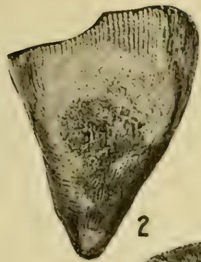
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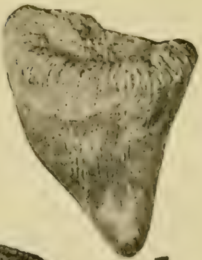
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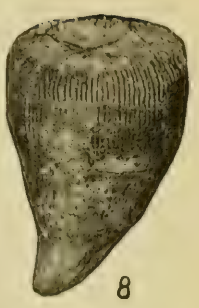
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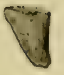
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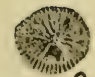
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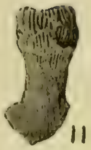
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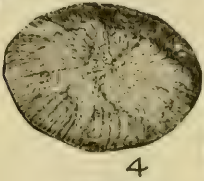
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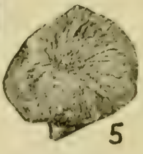
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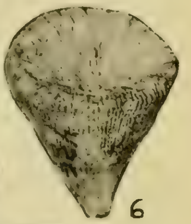
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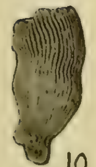
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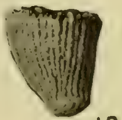
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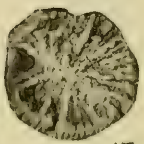
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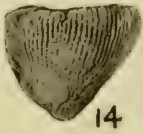
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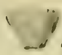
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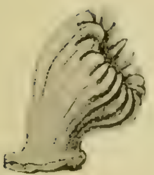
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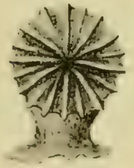
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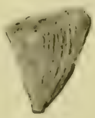
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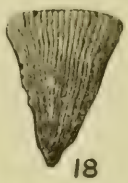
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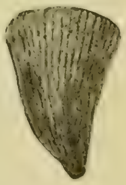
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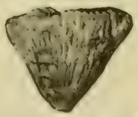
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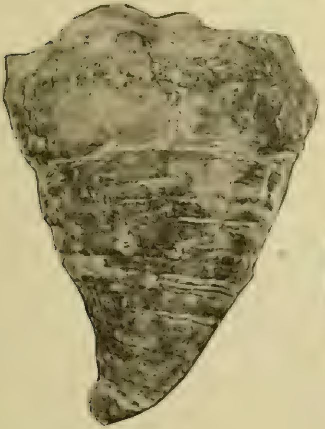
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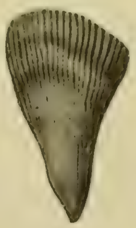
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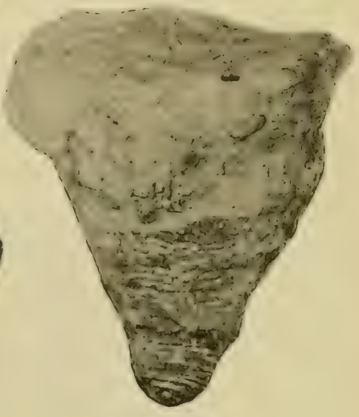
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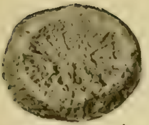
Plate 5 (18)

EXPLANATION OF PLATE 5 (18)

Figure		Page
1.	**Pleurosmilia saxi-fisi**, n. sp.	62
	Calice of type, x1.	
2.	Lateral view of type, x1.	
3.	**Pleurosmilia quaylei**, n. sp.	63
	Transverse section of type, x1.	
4.	Lateral view of type, x1.	
5.	**Pleurosmilia whitneyi**, n. sp.	62
	Lateral view of type, x1.	
6.	**Budaia travisensis**, n. gen. et sp.	66
	Lateral view of type, x1.	
7.	Lateral view of paratype, x1.	
8.	Calice of type, x2½.	
9.	**Stephanocoenia ? wintoni**, n. sp.	69
	Holotype, x1.	
10.	**Dendrogyra dumblei**, n. sp.	67
	Holotype, x1.	
11.	**Astrocoenia guadalupae** Roemer	74
	Plesiotype, x1.	
12.	Homeotype, x1.	
13.	Calices of plesiotype, fig. 11, x5.	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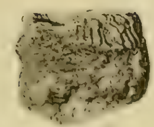
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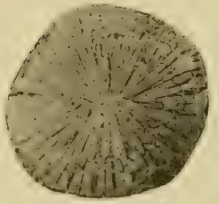
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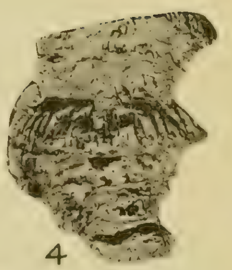
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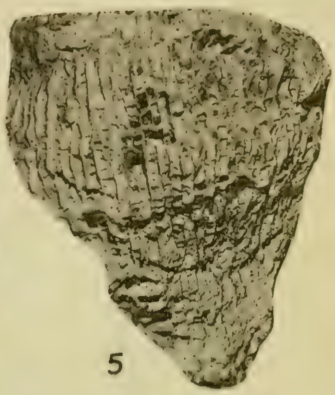
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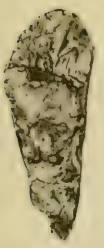
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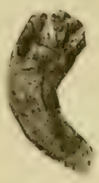
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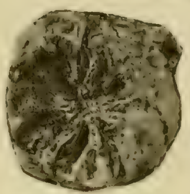
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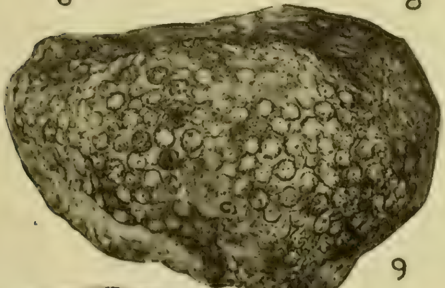
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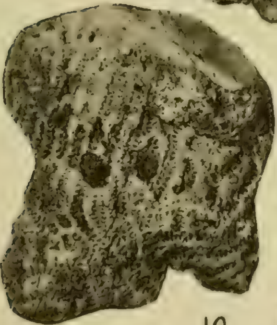
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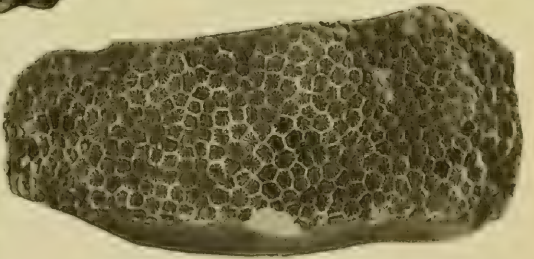
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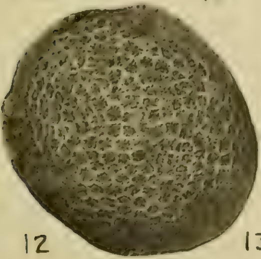
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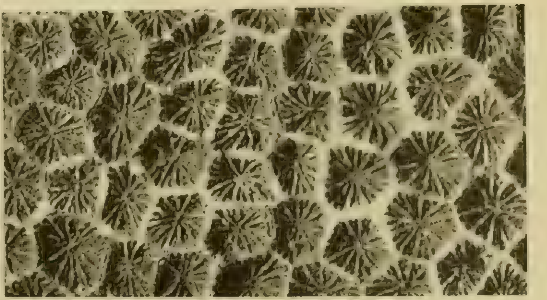
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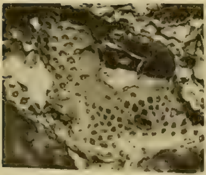
Plate 6 (19)

EXPLANATION OF PLATE 6 (19)

Figure		Page
1.	**Astrocoenia pattoni**, n. sp. Type, x1.	76
2.	Calices of type, x5.	
3.	**Astrocoenia budaensis**, n. sp. Calices of holotype, x5.	78
4.	**Astrocoenia nidiformis** Cragin Homeotype from Comanche Peak formation, x1.	73
5.	**Astrocoenia bellensis**, n. sp. Type, x1.	76
6.	Calices of type, x4.	
7.	**Astrocoenia whitneyi** Wells Calices of specimen from Quitman Mts., x4.	73
8.	**Cyathophora ? olssoni**, n. sp. Corallum of holotype, x1.	68
9.	**Orbicella edwardsensis**, n. sp. Upper surface of corallum of type, x2⅔.	85
10.	Calices of type, x5.	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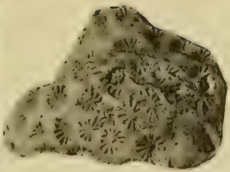
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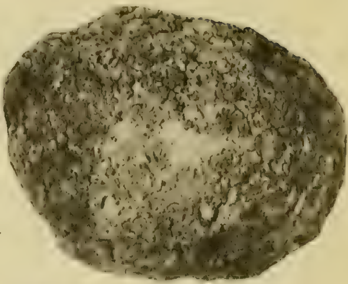
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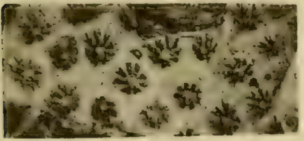
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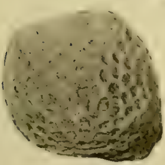
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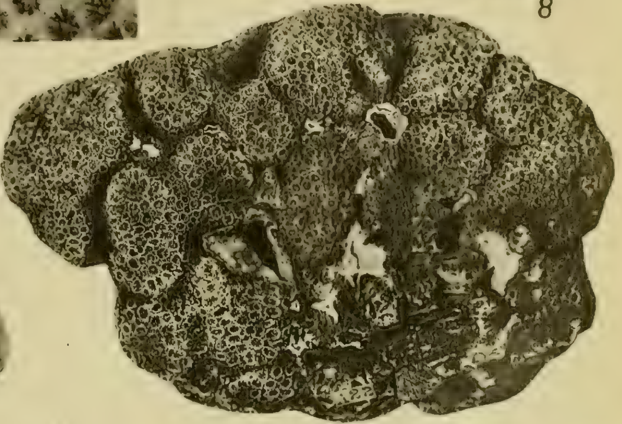
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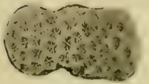
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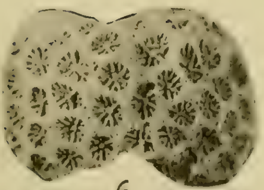
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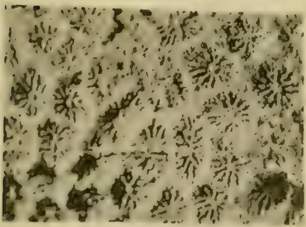
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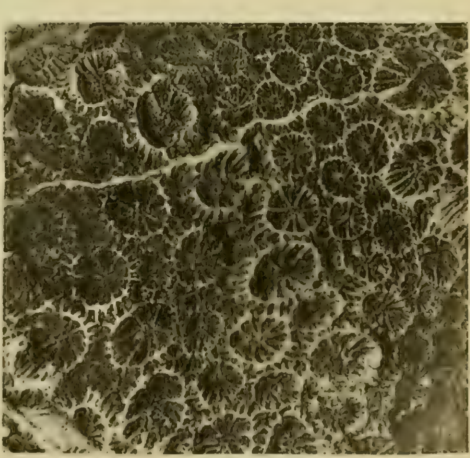
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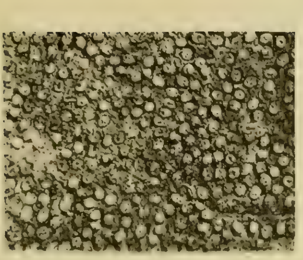
Plate 7 (20)

EXPLANATION OF PLATE 7 (20)

Figure	Page
1. **Orbicella ? texana** Vaughan	89
Homeotype, a cast, x1.	
2. **Orbicella pecosensis**, n. sp.	87
, Holotype, upper surface, x1.	
3. Lateral view of holotype, x1.	
4. Transverse thin section, x4.	
5. Calices, x5.	
6. **Orbicella roemeriana**, n. sp.	86
Type, upper surface, x1.	
7. Calices of type, x5.	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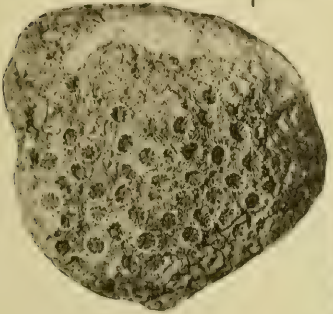
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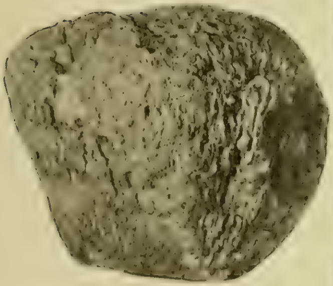
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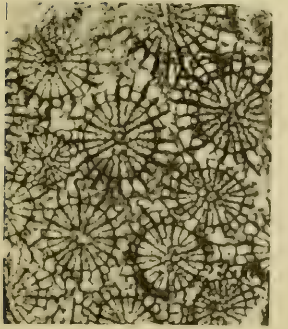
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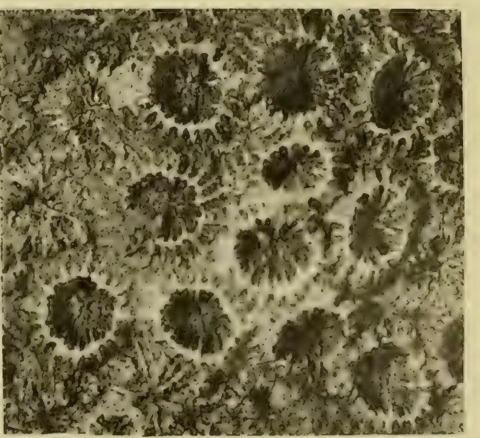

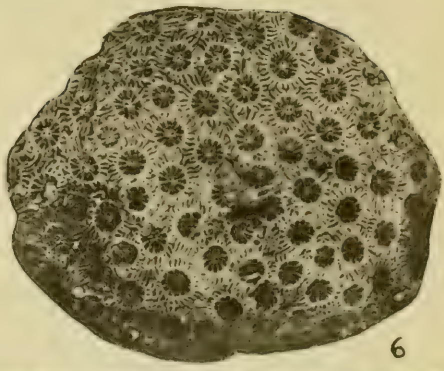
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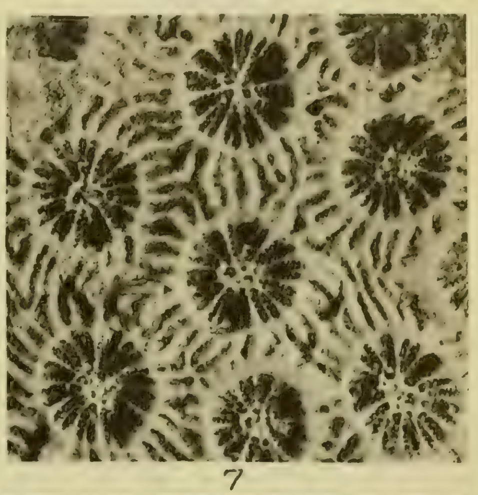
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PLATE 8 (21)

EXPLANATION OF PLATE 8 (21)

Figure Page

1. **Archohelia ? sp.** 80
Natural transverse section, x2.
2. Lateral view of specimen, x2.

3. **Placohelia ? richardsi,** n. sp. 82
Lateral view of type, x1.
4. Calices of type, x1.

5. **Cladophyllia furcifera** Roemer 90
Tophomeotype, a worn corallite, x1.
6. Tophomeotype, x1.
7. Tophomeotype, calice, x4.
8. Tophomeotype, x1.

9. **Pleurocora coalescens** Roemer 83
Tophomeotype, x1.
10. Tophomeotype, x2.

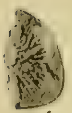
11. **Dendrosmilia ? texana** (Roemer) 80
Roemer's figure of the type.

12. **Diploastrea hilli,** n. sp. 93
Corallum of type, x1.

13. **Diploastrea ? vaughani,** n. sp. 94
Calicular surface of type, x1.
14. Natural vertical section on type, x5.

15. **Favoidioseris fredericksburgensis,** n. gen. et sp. 98
Paratype, x1.
16. Calices of paratype, x1.
17. Lateral view of paraytpe, x1.
18. Ideotype from Edwards Is., x1.

19. **Favoidioseris fredericksburgensis alta,** n. var. 100
Type, x1.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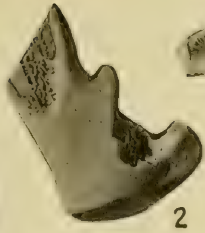
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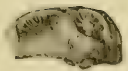
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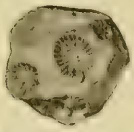
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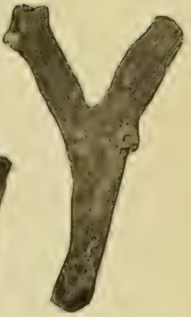
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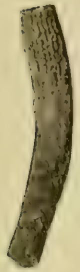
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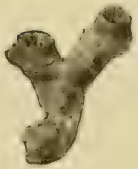
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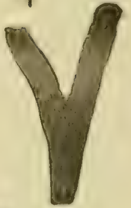
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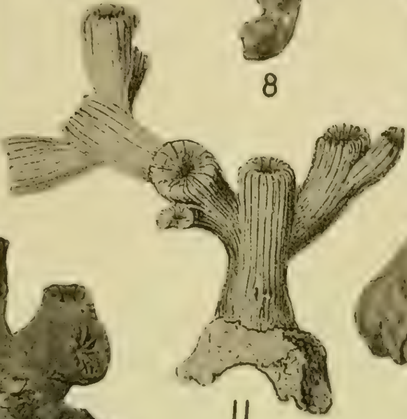
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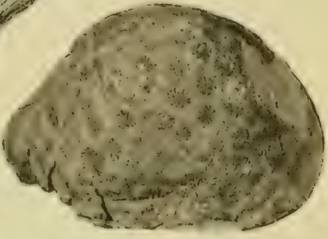
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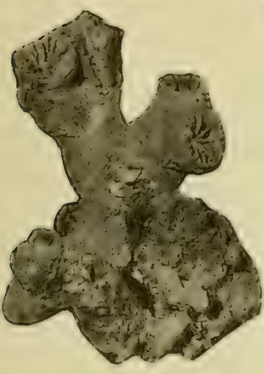
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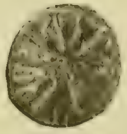
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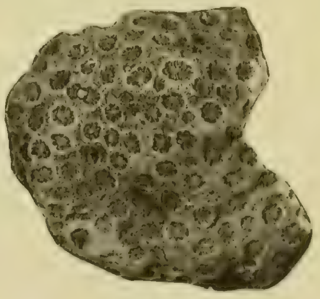
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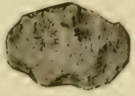
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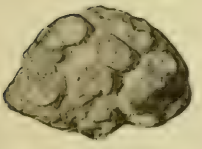
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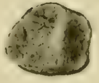
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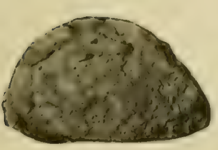
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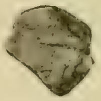
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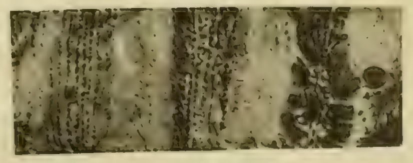
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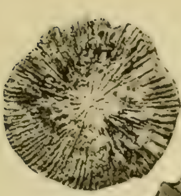
PLATE 9 (22)

EXPLANATION OF PLATE 9 (22)

Figure Page

1. **Trochoseris shattucki**, n. sp. 103
   Calice of type, x1.
   2. Lateral view of type, x1.
   3. Calice of type, x3.
4. **Favoidioseris pecosensis**, n. sp. 100
   Calicular surface of type, x1.
   5. Lateral view of corallum of type, x1.
6. **Siderastrea tuckerae**, n. sp. 104
   Calicular surface of type, x1.
   7. Lateral view of corallum of type, x1.



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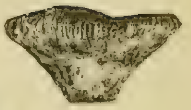

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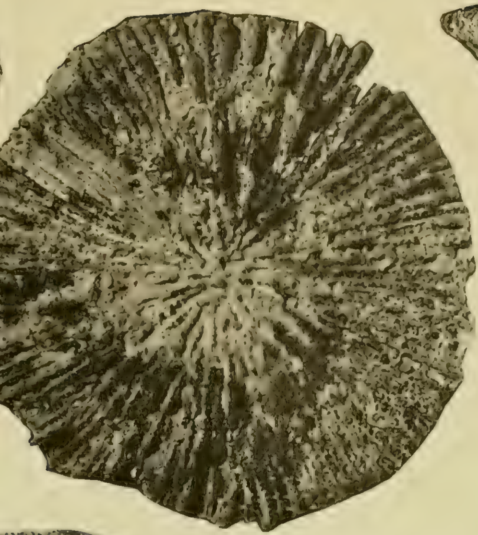

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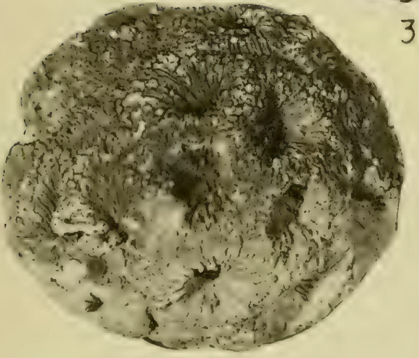

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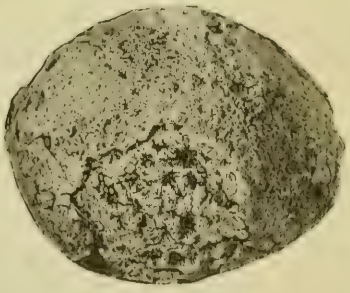

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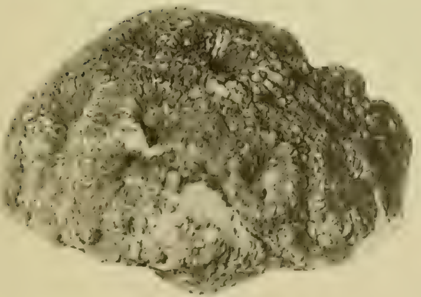

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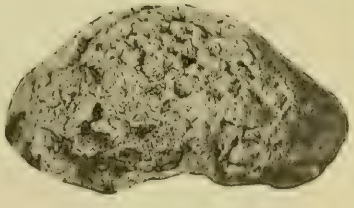

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PLATE 10 (23)

EXPLANATION OF PLATE 10 (23)

Figure Page

1. **Protethmos budaensis,** n. sp. 110
   Transverse section of type, x1.
   2. Lateral view of type, x1.
   3. Calice of paratype, x1.
   4. Lateral view of paratype, x1.

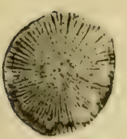
5. **Paracyclolites bakerae,** n. gen. et sp. 117
   Calice of type, x3.
   6. Transverse section of paratype, x2.
   7. Calice of type, x1.
   8. Lateral view of type, x1.

9. **Frechia ? sp.** 114
   Lateral view of specimen, x1.

10. **Dimorphastrea stantoni,** n. sp. 108
    Calicular surface of paratype, x1.
    11. Calicular surface of type, x3.
    12. Calicular surface of type, x1.
    13. Lateral view of type, x1.
    14. Calices of paratype, x1.
    15. Lateral view of paratype, fig. 14, x1.

16. **Stephanomorpha ? saxi-rotundi,** n. sp. 106
    Holotype, x1.
    17. Holotype, x2.

18. **Thamnasteria hoffmeisteri,** n. sp. 107
    Natural vertical section on type, x4.
    19. Worn calicular surface of type, x2.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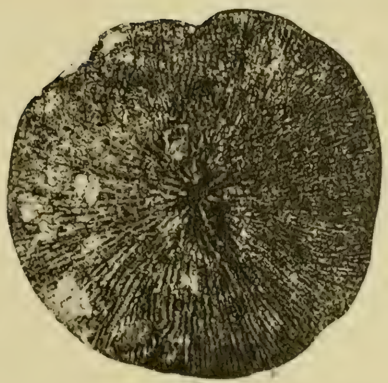
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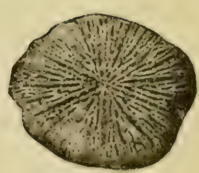
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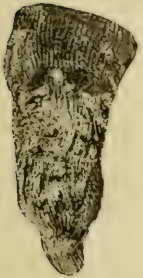
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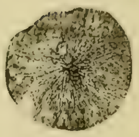
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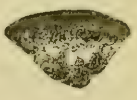
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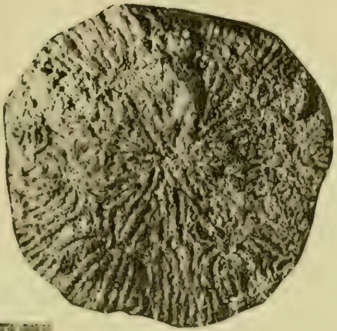
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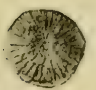
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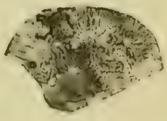
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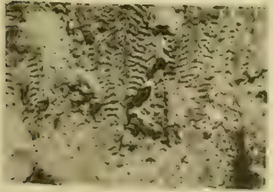
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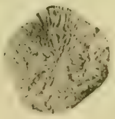
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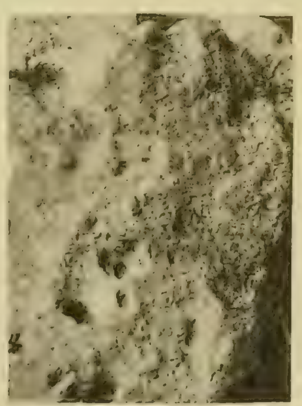
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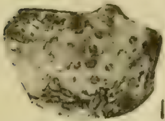
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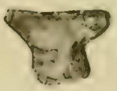
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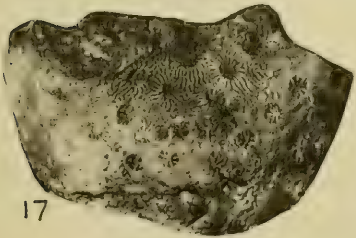
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Plate 11 (24)

EXPLANATION OF PLATE 11 (24)

Figure	Page
1. **Actinacis valverdensis**, n. sp.	120
Holotype, x1.	
2. Calices, x4.	
3. **Heterocoenia washitaensis**, n. sp.	119
Calicular surface of the type, x1.	
4. Lateral view of type, x1.	
5. **Dimorpharaea manchacaensis**, n. sp.	118
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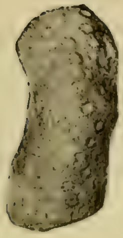
6. Calicular surface of young specimen, x3.	
7. Calicular surface of fig. 6, x1.	
8. Lateral view of fig. 6, x1.	
9. Transverse section of type, x3.	



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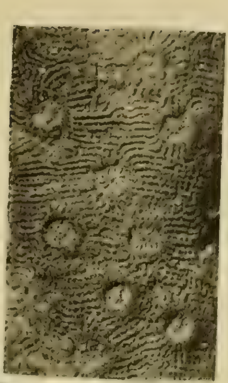

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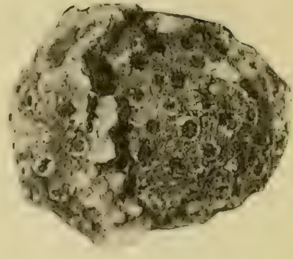

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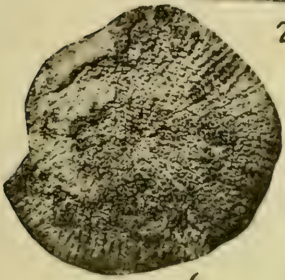

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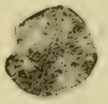

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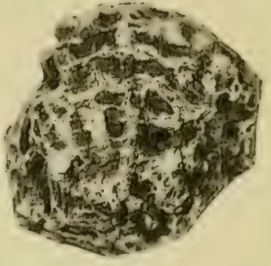

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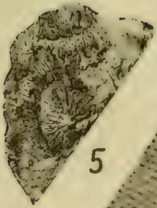

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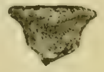

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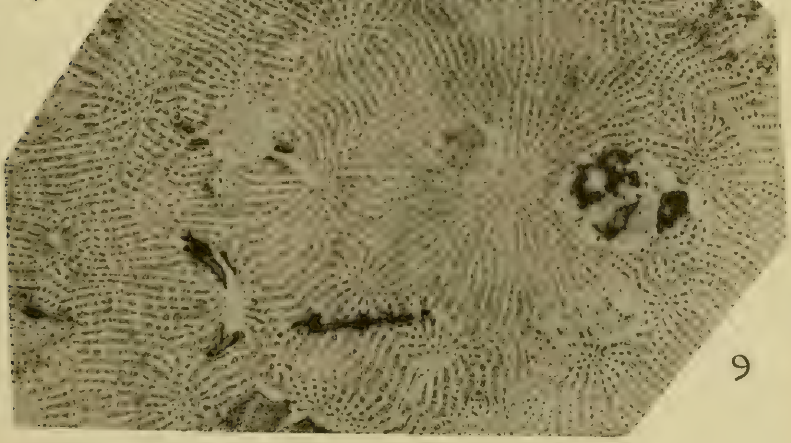

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Plate 12 (25)

EXPLANATION OF PLATE 12 (25)

DIAGRAMS

Figure		Page
1.	**Trochocyathus egerius** (White)	128
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2a-h.	Form of corallum of cotypes and plesiotypes, x1⅓.	
3.	Section of wall and 3 septa, x40.	
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	Costal plan, x5.	
5.	**Platytrochus** sp., of the Midwayan	122
	Costal plan, x5.	
6.	**Caryophyllia stephensoni**, n. sp.	124
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8.	**Dasmosmilia reesidei**, n. sp.	139
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9.	Wall and epitheca, x3.	
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11.	**Archohelia dartoni**, n. sp.	141
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12.	Vertical section of calice, x15.	
13.	**Siderastrea cretacea** (Bölsche)	144
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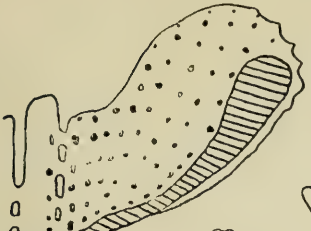
14.	**Wadeopsammia nodosa** (Wade)	146
	Septal plan of type, x8½.	
15.	Three septa and wall of the type, x17.	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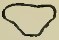
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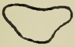
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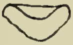
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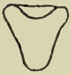
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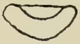
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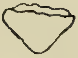
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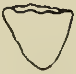
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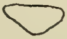
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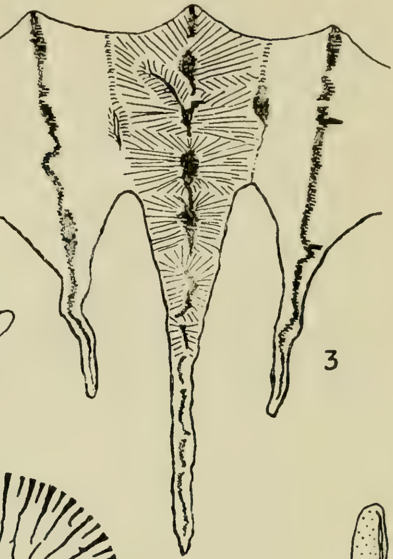
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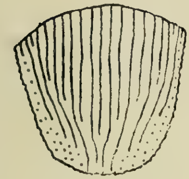
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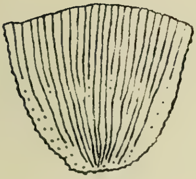
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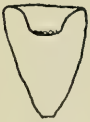
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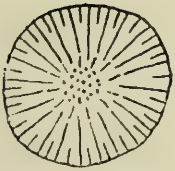
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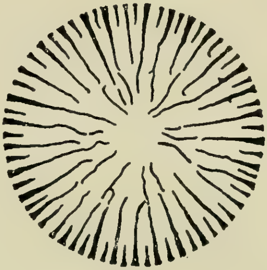
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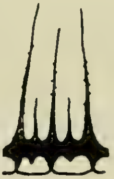
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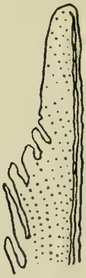
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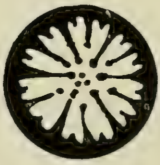
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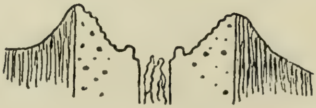
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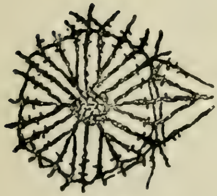
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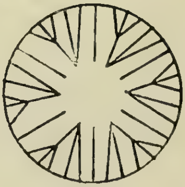
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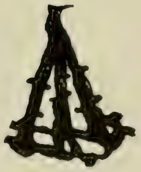
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PLATE 13 (26)

EXPLANATION OF PLATE 13 (26)

Septal plans of Micrabacids

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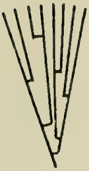

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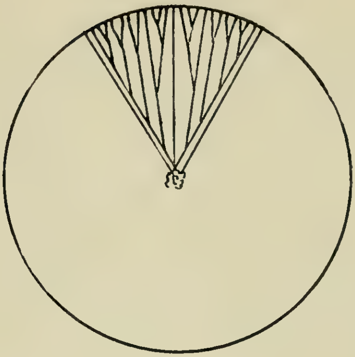

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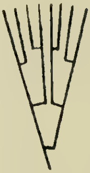

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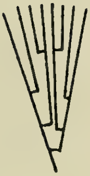

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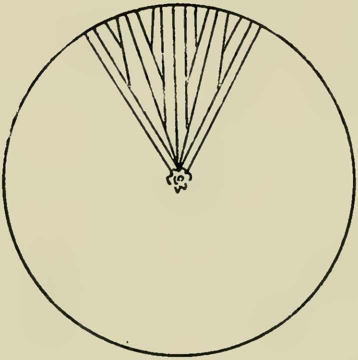

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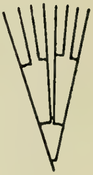

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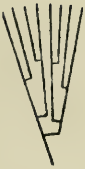

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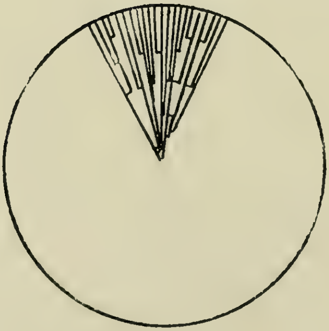

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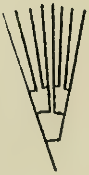

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PLATE 14 (27)

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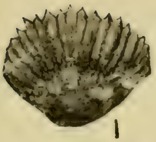
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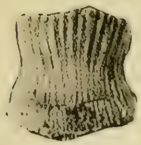
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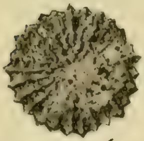
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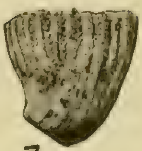
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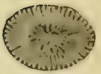
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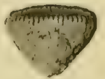
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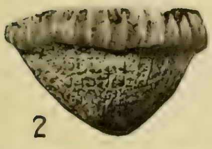
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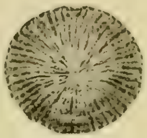
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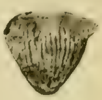
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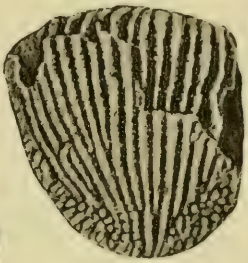
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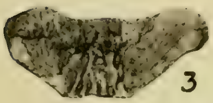
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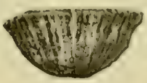
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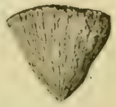
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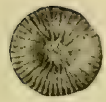
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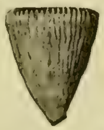
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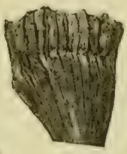
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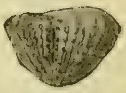
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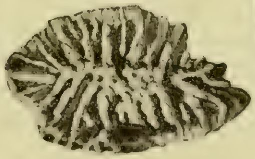
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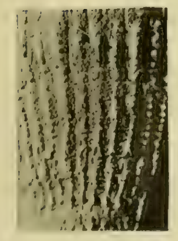
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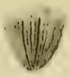
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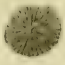
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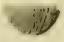
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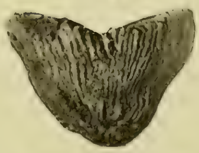
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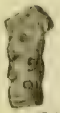
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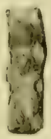
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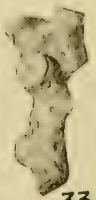
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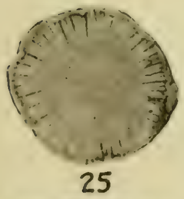
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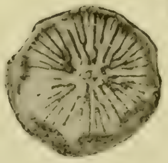
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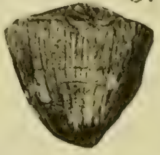
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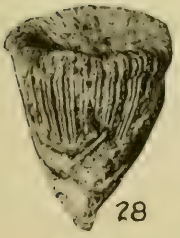
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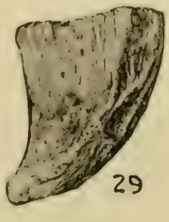
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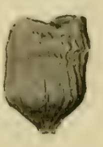
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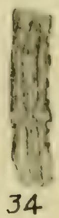
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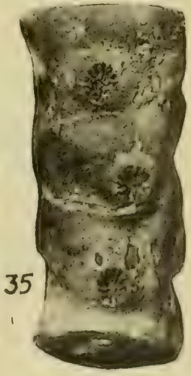
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PLATE 15 (28)

EXPLANATION OF PLATE 15 (28)

Figure — Page

1. **Micrabacia taylorensis**, n. sp. — 166
Calice of type, x4.
2. Lateral view of type, x4.
3. Basal view of type, x4.
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19. Basal view of type, x4.
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22. Calice of a paratype, x4.
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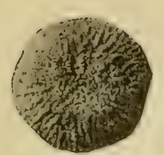
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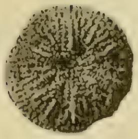
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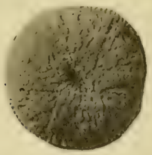
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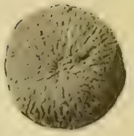
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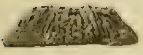
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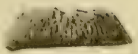
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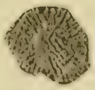
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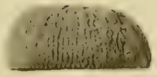
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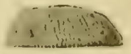
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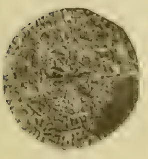
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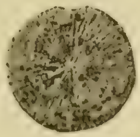
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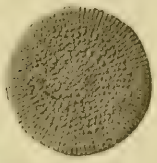
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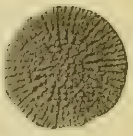
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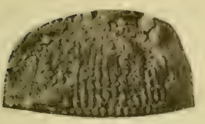
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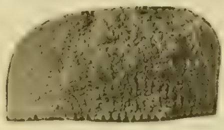
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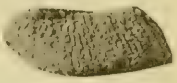
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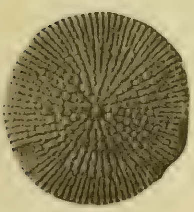
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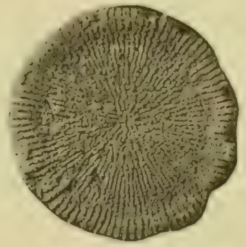
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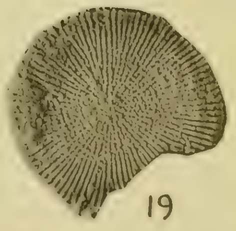
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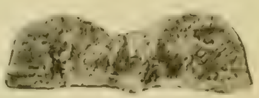
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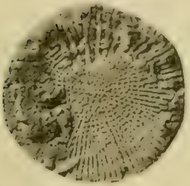
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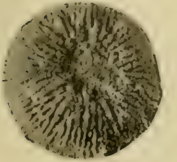
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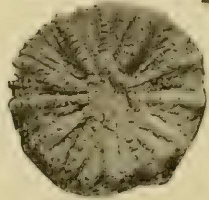
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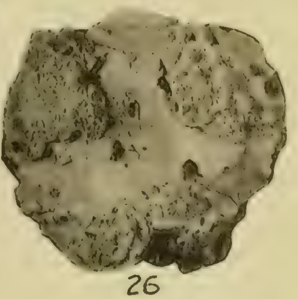
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PLATE 16 (29)

EXPLANATION OF PLATE 16 (29)

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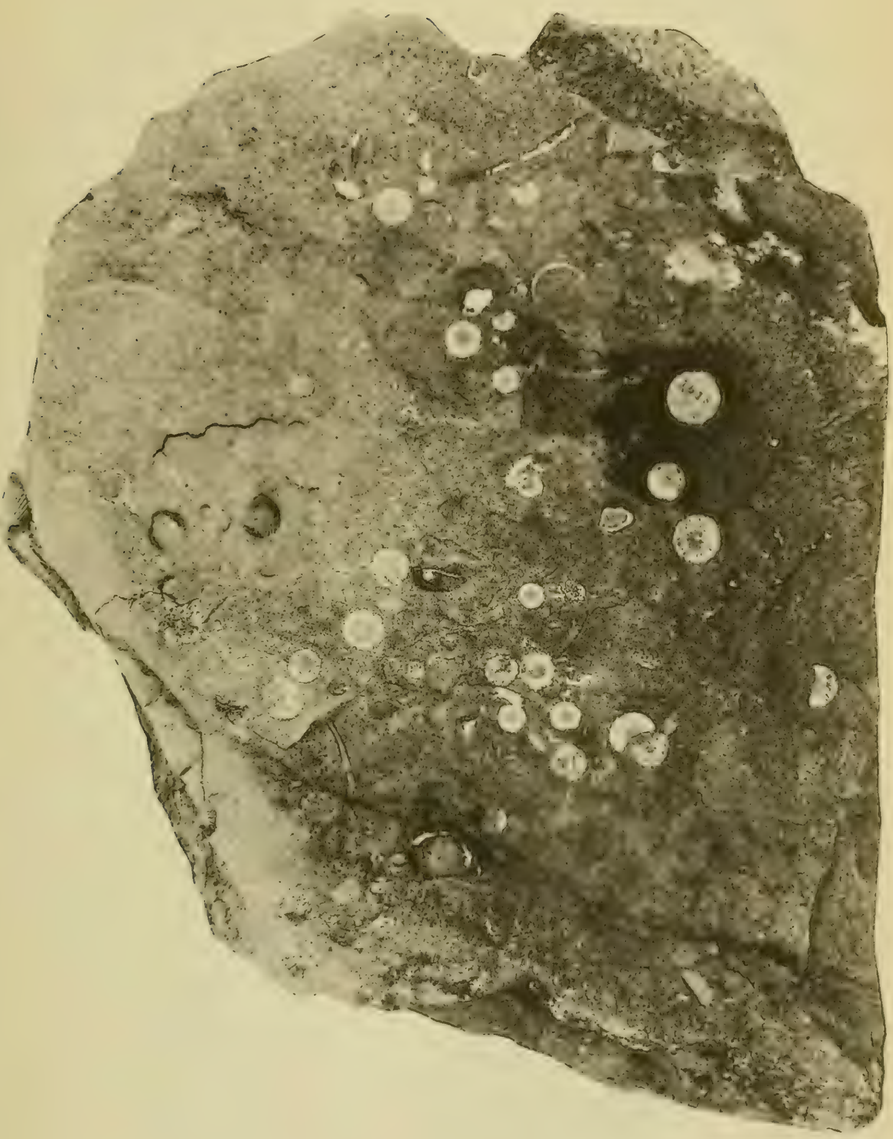
Micrabacia americana Meek. Homeotypes on a slab of sandstone from a concretion zone at the base of the Fox Hills sandstone at the east end of Greasewood Dome, near Jackson Reservoir, Morgan County, Colorado, collected in 1932 by J. B. Reeside, jr. x½.



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